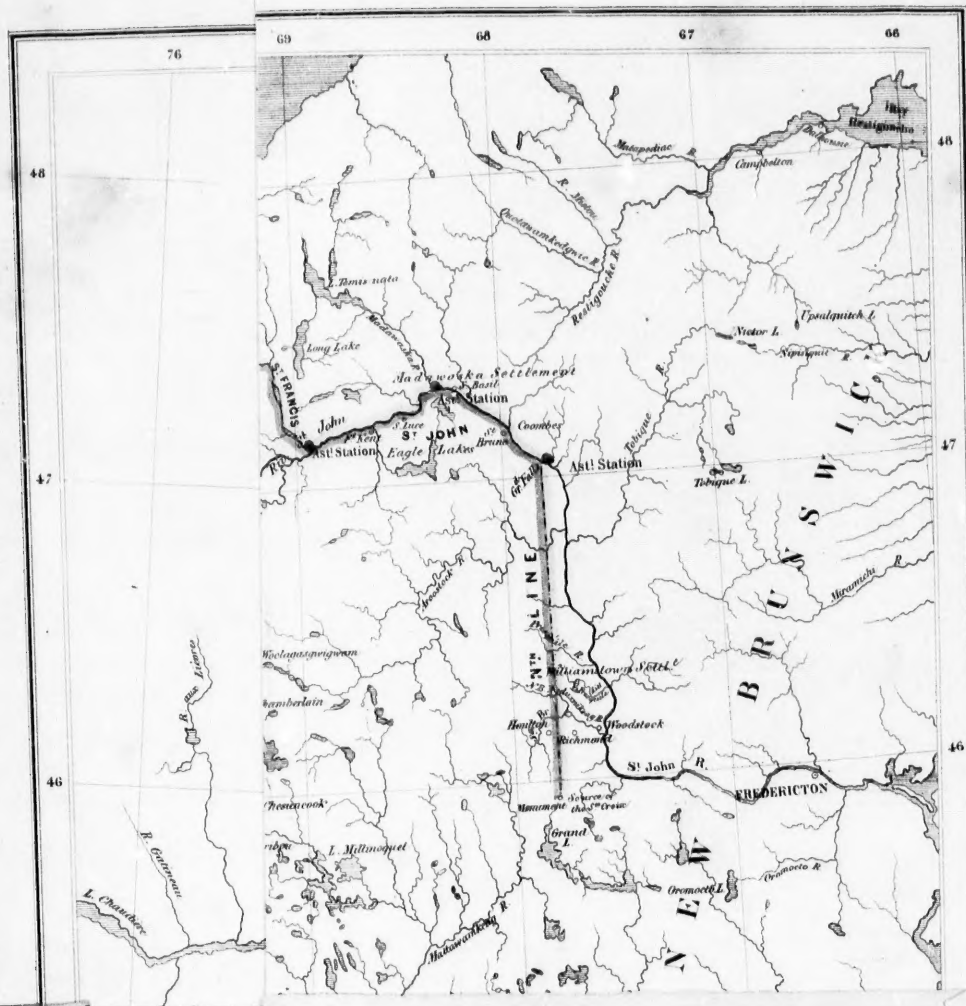






NORTH AMERICAN BOUNDARY.

NARRATIVE

OF THE

SURVEY BY THE BRITISH COMMISSION,

OF

THE BOUNDARY

BETWEEN THE

BRITISH POSSESSIONS IN NORTH AMERICA

AND THE

UNITED STATES OF AMERICA,

UNDER

THE TREATY OF WASHINGTON OF 9TH AUGUST, 1842.

MAP

SHEWING

THE LINE OF BOUNDARY

BETWEEN

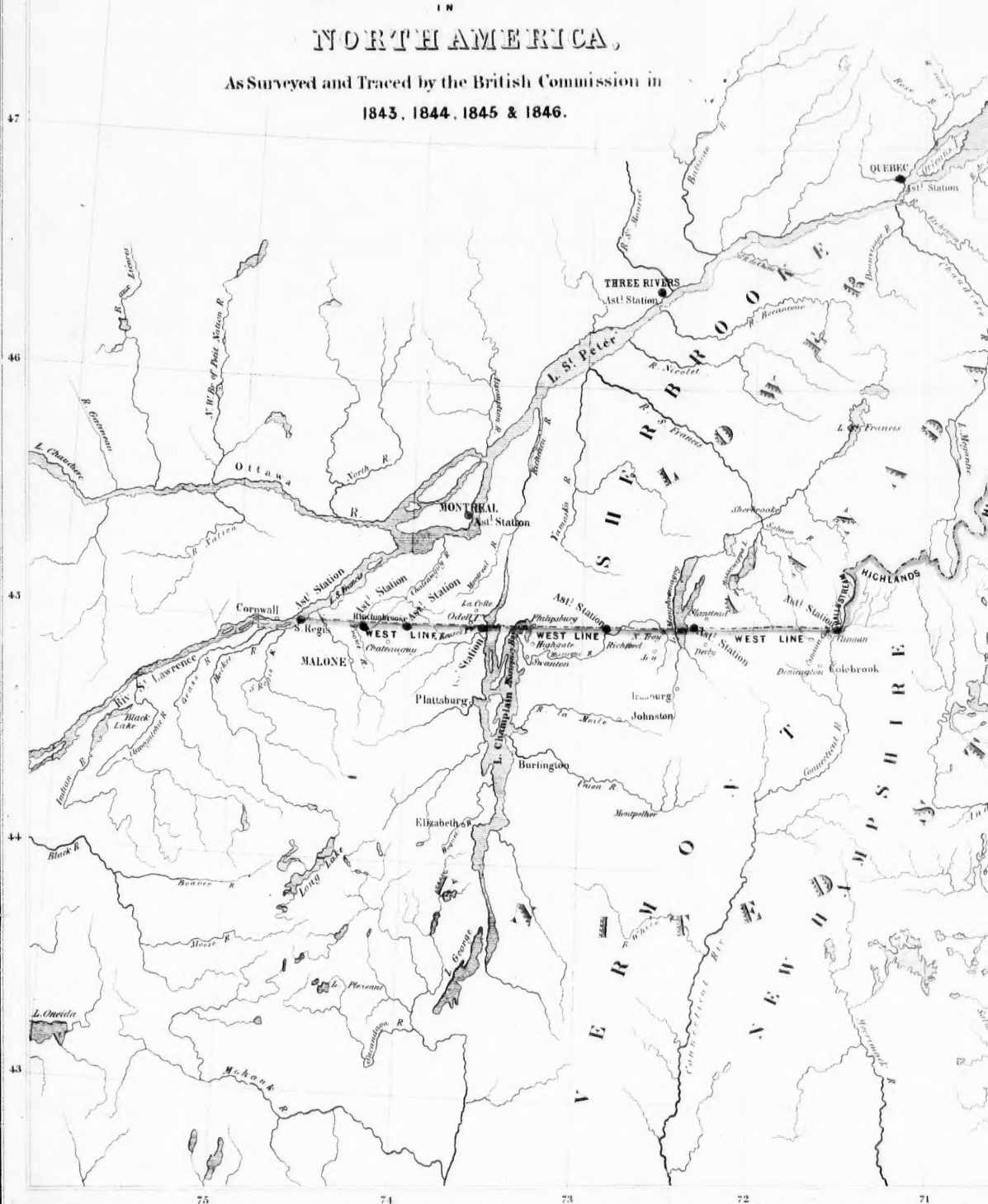
The British & United States Territory

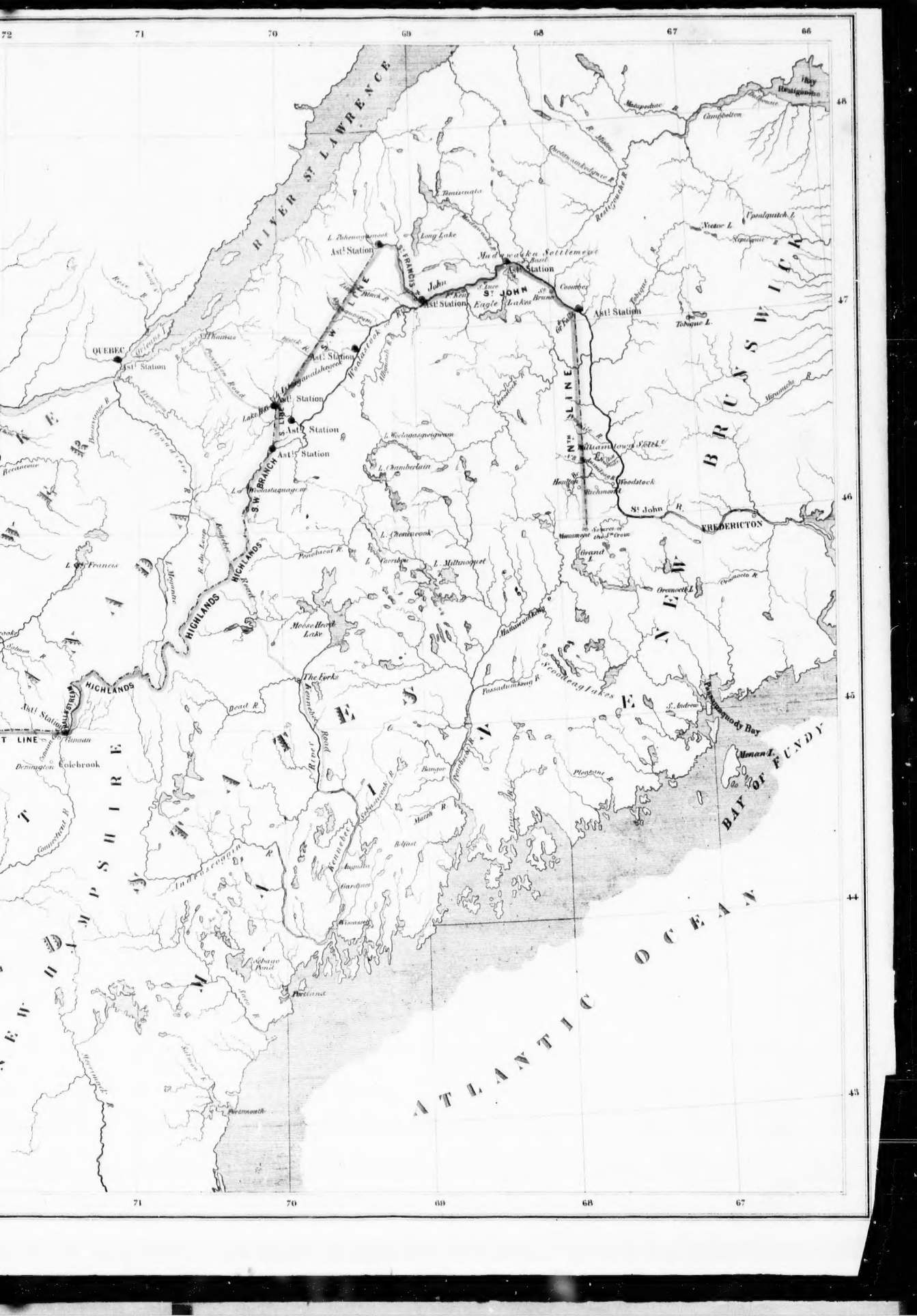
IN

NORTH AMERICA,

As Surveyed and Traced by the British Commission in

1843, 1844, 1845 & 1846.





THE AMERICAN BOOK DAY

THE AMERICAN BOOK DAY

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Narrative of the Survey, by the British Commission, of the
Boundary between the British Possessions in North
America and the United States of America, under the
Treaty of Washington of the 3th August, 1842.

1843

THE British Commission was composed of a Commissioner, a secretary, two astronomers, who were selected from the corps of Royal Engineers, two surveyors, one of whom was also from the corps of Royal Engineers, and one a civilian, and six non-commissioned officers of the corps of Royal Sappers and Miners, who had been for a long time employed on the ordnance survey of England. These last were found to be so useful, that in the second season, when the operations of the Commission were to be greatly extended, they were increased in numbers to twenty.

Previous to leaving England the two officers who were to take the part of astronomers, received from Professor Airy, the Astronomer Royal, instruction at Greenwich in the particular description of observations which he thought suited to the service to be performed. He also superintended the selection of the instruments best fitted to the objects contemplated. They were, for the astronomical purposes, transits, altitude and azimuth instruments, box and pocket chronometers, sextants, and a liberal allowance of thermometers and barometers. For surveying purposes the instruments provided were theodolites, chains, and Schmalchalder's compasses.

The Commission left England in two detachments. The first, consisting of the Commissioner, the secretary, and one surveyor, sailed in the steam-packet from Liverpool on the 4th of April, 1843; and the second on the 19th of the same month. They both landed at Boston; thence re-embarking on board a coasting steamer, they sailed to St. John's, New Brunswick; and thence by the river boats proceeded to Fredericton. In the meantime the Joint Commission was opened, according to the direction of the Treaty, at Bangor in the State of Maine, on the 1st of May, the British and American Commissioners meeting there for that purpose.

At this time the winter was not entirely over: the ground was in general bare of snow, though still there were patches to be seen scattered about in ravines and gullies. In the woods it was even quite deep, in consequence of a recent heavy fall. The 1st of June, therefore, was agreed upon as the time to begin operations; and the interval was to be employed in making preparations. Tents were to be made; provisions collected; camp equipments procured; and axe-men to be hired. On the British side, Fredericton was for the time head-quarters. The tents were procured at Boston; the provisions purchased at St. John's; the men hired at Fredericton; and the boats, of which there were to be in the first instance eighteen, were built at Woodstock. One other officer was engaged at Fredericton as a surveyor, who had been employed in previous explorations relative to the disputed Boundary, before the Ashburton Treaty set the matter at rest.

1843

After leaving Fredericton the Grand Falls was appointed to be the first place of rendezvous for the British Commission; there everything was to be carried, and a principal depôt to be formed of all such stores as might be wanted for the first season, so far at least as they could be ascertained beforehand.

On the first arrival of the Commission at Fredericton the floods were out on the River St. John; and indeed so great had been the rush of ice borne down by the melting snows, that every bridge had been carried away from the Grand Falls to Fredericton, but as soon as these had been temporarily repaired, and the waters had subsided, the Commission removed to the Grand Falls, and from thence began its operations.

These will be described under the different heads of—

1. North Line.
2. St. John.
3. St. Francis.
4. South-West Line.
5. South Line.
6. South-West Branch.
7. Highlands.
8. Hall's Stream.
9. West Line.
10. Astronomical Operations.

These divisions have been adopted for convenience; and a reference to the map accompanying this narrative will, it is supposed, afford a clear idea of the portion of country to which they each relate.

The labourers employed by the British Commission at the beginning of the first season were comparatively few. They did not exceed fifty; but as soon as the cutting of the Line began, they were increased to about 120, and afterwards, in the second season, for the cutting of the Highlands, they amounted to near 500.

Of course preparations on rather an extensive scale were required to provide for the subsistence of so many men at great distances from settlements. Their numbers involved also the necessity of building in several places, houses for the stores and for those placed in charge of them. The sort of house was a log-house, in the construction of which lumbermen are very skilful. The principal part of the work is done with the axe alone. The roofings are made of shingles, *i. e.* pieces of split wood, of the shape and size of slates, laid overlapping each other. Two panes of glass are introduced into the wall to give light; and a small sheet-iron stove makes the house complete. The bed is always made of twigs of the spruce tree placed at an inclination upwards, and lying one upon the other after the fashion of the feathers of a bird; nothing can be more comfortable or more fragrant.

The boats which were used by the Commission were of three sorts: those called "bateaux," which are flat-bottomed and sharp at both ends; those called pirogues, or log-canoes, which are made by hollowing out a spruce-tree and shaping it; and birch-bark canoes, which are made and used almost exclusively by the Indians. These last are too delicate for carrying heavy burdens. The pirogues are commonly used by the settlers, but they require careful management; whilst the bateaux, which are more properly the boats of the Penobscot, will bear a heavy load, and are not easily upset. They were in consequence preferred for general purposes by the Commission.

For carrying burdens on men's backs a sort of frame was invented, which enabled them to carry barrels and inconvenient loads, as easily as those which fitted better on the back.

The axe-men were in the first place settlers from New Brunswick; but afterwards, as the work approached the Canadian frontier, they were engaged from amongst the Canadians, and chiefly from the neighbourhood of Three Rivers. Both descriptions were excellent men, whose energy and endurance were equal to any occasion, and who submitted willingly to the strict discipline which was maintained in the camps of both Commissions.

Though the drain on the constitutions of the men, both from the cold of winter and the great heat of summer, was severe, yet they were for the most part free from sickness. Fevers were only known amongst those who, having been some time in the woods, where there is but little wind, went out into clearings. In the spring, and only in the spring, scurvy was common amongst those who had passed the winter in the woods. The gums became sore, the teeth loose, the legs discoloured, and the whole frame emaciated; but raw potatoes or cream of tartar alleviated the sufferings at once, and a change of diet to fresh vegetables and fresh meat out of the woods, soon restored the patient to his usual health. Of injuries there were very few, considering the number of axes which were in motion every day. Axe-men are exceedingly careful to clear away every little twig around the tree they are about to fell, knowing how small a matter will turn a falling axe. There were but three formidable wounds from the axe, and one injury from the falling of a tree. The falling of the tree dislocated the hip of a poor man employed close to it, and crippled him for life. The wounds did not in either case occasion death, but they were formidable from their depth and size, and from the impossibility of having recourse to a surgeon. All the officers were provided with a few simple medicines, needles, thread, plaster, and a tourniquet, which they used as well as they could.

The narrative will now describe the nature of the survey throughout its different portions under the heads already enumerated.

North Line.

The Treaty fixed upon the Exploring Line of Colonel Bouchette and Mr. Johnson from the head of the St. Croix northwards to the River St. John, as the Boundary between the British and American possessions. That line had therefore to be sought out; and in consequence, a party from the British Commission was directed to go in company with a party from the United States' Commission, and if possible to trace it.

From the monument at the source of the St. Croix, which there was no difficulty in finding; and which agreed with the description given of it by Colonel Bouchette, the parties at first followed a well marked line, which it was easy to see had been cut out to some certain width. It was to be recognised by the trees along it being evidently of a younger growth than the rest; and also by a sort of dip, which was to be observed when looking up, and following with the eye, the line of the tops of the trees against the sky.

That line carried the parties to a meadow about half a mile north of the south branch of the Meduxnieag River, when it suddenly stopped. Neither Commission had at the time any information to account for this, and some perplexity was the consequence.

After searching about for some time, the parties discovered to the east of the line which they had been following, a line of blazes, which ran north, and appeared to resemble the character of the blazes, by which the northern portion of the North Line was understood to be marked: for it was known that the upper or northern portion of the North Line had been blazed two or three times over, and that it was marked in that way, but that it was not cut out.

The parties, therefore, followed the above-mentioned blazes northwards, until they came, after seventeen days from the time they began the exploration, to the River St. John.

On the way they fell in with marks on the trees and posts, which confirmed the identity of the Line with that of which they were in search.

After reaching the St. John's, they returned and followed back the same blazes southwards from the point at which they had at first fallen in with them; and in due time they found themselves carried back to the monument at the source of the St. Croix.

The whole Line thus explored passed through forest, some of it, especially towards the source of the St. Croix, exceedingly entangled.

There were however a few clearings for cultivation, at Green's; about the Houlton Road; at Watt's, on the south branch of the Meduxnieag;

North Line.

1843

North Line.

on the left of the Presqu'isle River; on the banks of the Aroostook; and again on those of the St. John.

With regard to the line, which had been supposed at first to be the true one, and which had been followed to the meadow, as already stated, its history was ascertained from Mr. Campbell, who had been one of the assistant surveyors under Colonel Bouchette, and who was still living at St. Andrews in New Brunswick. Upon application being made to him, he sent his field-notes for examination, from which it appeared that Colonel Bouchette and Mr. Johnston had in 1819 gone a-head with an exploring line, directed by compass, leaving their assistants to trace, and cut out to the width of sixteen feet, a more exact due north line; but those gentlemen, after running their line to the meadow above mentioned, found themselves so far from the exploring line of their principals, that they doubted their own accuracy; and not being able to agree on the matter, they stopped altogether, and left the woods.

After the North Line had been traced, and re-blazed by the Boundary Commission in 1843, parties were employed to cut it out to the width of thirty feet; it having been agreed that all portions of the Boundary which should pass through woodland should be opened to that width.

The American Commissioner undertook to cut with his parties that portion of the Line which was south of the Presqu'isle River, whilst the British Commissioner with his parties cut all that was north of it.

After the Line had been cut out it was surveyed by a party from each Commission.

The mode of determining where the precise Line should be, was, by running a succession of courses, and making each any length most convenient, provided it did not stretch out beyond the cutting of thirty feet width.

The general bend of the Line was to the west: until near the St. John its deviation from the meridian of the St. Croix, measured on the perpendicular, amounted to 2,197.8 feet. This measurement was obtained on the perpendicular drawn from the Transit Station of the British Commission at the Grand Falls.

At each mile, and at each angle of deflection, as well as at the crossings of the roads, where any occurred, or at those of the rivers, an iron post was set up. The posts were cast at Boston, of an uniform pattern. There were two sizes: a large size, which was placed at the principal points, such as the source of the St. Croix and the intersection of the St. John, on the North Line; and at other points upon other portions of the Boundary, of which mention will be made by and bye; and there was a smaller size, which was placed at intervals all along the Line.

River St. John.

River St. John.

The River St. John was surveyed by two parties from each Commission. One British and one American party surveyed in company upwards from the Grand Falls to the mouth of the Madawaska; and another British with another American party surveyed downwards from the mouth of the St. Francis to the mouth of the Madawaska, where the two surveys were brought together.

In the neighbourhood of the islands soundings were taken to ascertain the deep channel; and by them the Commissioners determined on which side the Boundary should be made to pass.

The only island about which there arose a doubt was La Septième Isle; and in that case the Commissioners determined to apportion it to the side on which the greater number of the owners should be found to live. By that decision it fell to the United States.

The banks of the river are settled nearly all along from the Grand Falls to the Madawaska River. Above that point the settlements are less frequent.

River St. Francis.

River St. Francis.

The River St. Francis was surveyed by a party from each Commission acting together.

The outlet of Lake Pohenagamook was determined and marked.

The whole course of the St. Francis was through uncleared woodland. The scenery on it was very beautiful: the trees rich with foliage; the width of the river sometimes diminishing to a narrow channel, and then again opening out broader, and even spreading itself into large and long lakes.

Lake Pohenagamook is the third principal lake, and is about six miles long.

Before relating the astronomical operations, it will be necessary to mention what arrangements were made for supplying with provisions the parties to be employed in the Valley of the St. John beyond the St. Francis.

Up to the St. Francis, the St. John, though shallow in parts, was yet generally capable of floating a flat-bottomed boat, called a "scow;" but above the mouth of the St. Francis it was found to be for the most part, except when swollen by an unusual quantity of water, too shallow for transporting any large quantity of provisions. It was therefore necessary to seek some other route. That which was determined on was to cut a road through the woods from St. Thomas, a town on the St. Lawrence, about thirty miles below Quebec, to the north-west branch of the St. John; a distance, as it turned out, not less than forty-one miles. Bridges and causeways, wherever necessary, were constructed upon it. It was begun from the side of St. Thomas; and thus as the provisions were wanted for the workmen, they were carried in by them on carts by the road they were cutting.

A triangulation was being made at the same time of the country intervening between the North-West Branch and the crest of the dividing ridge towards the St. Lawrence, in which direction it so happened fortunately, that there were several prominent hills, which facilitated the operation.

Astronomical Operations.

A chain of astronomical stations was established between the Grand Falls and the outlet of Lake Pohenagamook. Comparative longitudes were obtained between those stations by interchanges of chronometers; thus, the Grand Falls and the mouth of the Madawaska River were the first stations taken up. As soon as the officers had determined the time at their stations, chronometers were transmitted from one to the other.

Astronomical
Operations.

After that had been satisfactorily accomplished, the Grand Falls were abandoned, and the mouth of the St. Francis was taken up; and then the connection was made between that and the Madawaska. Then the Madawaska was given up, and the outlet of Lake Pohenagamook was occupied.

In this manner the Grand Falls were connected astronomically with the outlet of Lake Pohenagamook, which being accomplished, the second object was to connect the outlet with a certain point on the north-west branch of the St. John, which was determined according to certain conditions of the Treaty. For it was directed that the Boundary between those points should be a straight line; and the whole intervening country, a distance of more than sixty miles, being one unbroken forest, it was necessary to connect those two points astronomically in latitude and longitude, and so to compute their azimuths.

To effect this a chain of stations was taken up by the only practicable, though circuitous, route of the St. Francis and the St. John, in the same manner as had been already done between the Grand Falls and Lake Pohenagamook.

They were—

1. Outlet of Lake Pohenagamook.
2. Mouth of the St. Francis.
3. Mouth of the Great Black River.
4. The Forks of the St. John, or end of the Ten-Mile Line.

This Ten-Mile Line had been cut by the American Commission from the St. John to the point fixed on the North-West Branch. It was a mea-

sured distance of ten miles; and besides being the means of fixing the point on the North-West Branch, it served to complete the connection between the outlet and the North-West Branch.

But before these operations were finished winter had set in; the communication between the stations had ceased. The last party which attempted to pass between the mouth of the Great Black River and the Forks, had been obliged to abandon their canoe, and scramble the rest of their journey along the sides and banks of the river. It had been determined, however, beforehand, to endeavour to persevere, notwithstanding the winter; and accordingly preparations had been made: houses had been constructed, in which it was hoped the parties would be able to remain during at least so much of the winter as might be found necessary; and stores and provisions had been laid in.

After the river had become impassable for canoes, the parties waited for it to freeze, hoping that it would prove possible to effect a communication by sleighs.

The interval which elapsed between the closing of the navigation by canoe, and the opening of it by sleigh, was ten weeks; *i.e.*, from the beginning of November to the 10th of January.

The arrangement for carrying the chronometers by sleighs required a stable for a change of horses intermediate between the astronomical stations; and the service was attended with a great deal of exposure; so much so, that it required great persuasion and management at times to induce the Canadians, who had undertaken the employment, to continue in the service. Their horses suffered for want of good stabling, and from the fatigue attending their journeys: continually they were obliged to break a fresh track through the recently fallen snow; and frequently to stop to strike off the heavy burden of ice, which would collect and attach itself about the fetlocks of the animal. The service was however successfully accomplished; and thus a complete connection was made between the extremities of the long South-West Line; and the data were obtained for computing the direction of one from the other.

The parties then left the woods by the way of St. Thomas.

The winter was employed also in carrying in to the dépôt on Lake Ishaganalshegeck, on the North-West Branch, a very large supply of provisions; enough in fact to last for all the remainder of the operations likely to be required in the Valley of the St. John. They were carried in on sleighs, and an officer was placed in charge of them.

Using that as the principal dépôt, other subsidiary dépôts were formed: one at the opposite side of the Lake Ishaganalshegeck; another at the Forks, or end of the Ten-Mile Line; another at the mouth of the Great Black River; and another near the outlet of Lake Pohenagamook: but this last was supplied from Rivière du Loup by a road cut by the lumbermen from Fournier's on the Temiscouata Portage Road.

In this way provisions were stored in sufficient quantities and in convenient dépôts, for the operations calculated on for the Valley of the St. John.

The foregoing operations may be considered as those of the first season, though they did in fact extend through the whole of the winter.

They are shortly comprehended in the following:—

A survey of the North Line.

“ St. John River, with its islands.

“ St. Francis River.

Astronomical data for computing the azimuth of the South-West Line.

And a large supply of provisions collected at certain dépôts.

The month of February being permitted to pass in inactivity, the Commission was again ready in March to begin operations; and it was determined to take advantage of the hollowness of the woods, and the absence of foliage and of the snow, which covered up the obstructions on the ground, and made it easier to pass between the trees with snow shoes. Accordingly, by the 1st of March the two sets of labourers were on the ground, one at Lake Pohenagamook, and the other at the North-West

Branch; and preparations were made for running a trial line from both ends at once.

The following was the mode of proceeding at the North-West Branch:—

The azimuth of the line to be run, which had been computed from the astronomical data, as already mentioned, was first laid off with a large altitude and azimuth instrument, and then the line was prolonged with a transit.

It so happened, that after running about four miles, the Line passed over the shoulders of a hill which rose like a sugar-loaf; and after removing the transit to that point, it was found to command a view over the tops of the successive ridges for nearly forty miles. This was great luck, which the party at Lake Pohenagamook did not share. They, on the contrary, had their view obstructed by hill after hill, entailing frequent removals of the transit.

The party which actually ran and cut the Line, worked their way by compass; but at night they were enabled to obtain a correction for themselves from the Transit Station, in the following manner:—A torch of birch bark was visible with great ease even to the distance of forty miles; also flashes of gunpowder fired in an open pan could be seen to at least the same distance. Signals were agreed upon, as thus:—One flash, "Move more to the right;" two flashes, "Move more to the left;" three flashes, "Halt;" and four flashes, "All right." As soon as it became dark the torch was set up by the working party; the officer at the transit observing the deviation of the torch from the true position, made signals, in obedience to which the torch was moved, until it was seen to be bisected by the centre wire of the transit. When that was the case, the signal of four flashes was made, and a post firmly driven into the ground was substituted for the torch. In due time the parties from the opposite ends were expected to be approaching each other, though no communication had been as yet opened between them; and great was the anxiety to learn how near they were drawing to each other, and what amount of error there would be between the two lines. The first indication of the cutting party from Lake Pohenagamook was an apparent dip or opening on the outline of the tops of the trees seen by a man who had climbed a tree to look out. The suspicion that it might be the other party, became a certainty that it was so by the opening being observed to grow larger; at length they came along side of each other, when their deviation from the correct course was found to be only 341 feet, *i.e.*, an error for each of 170½ feet, supposing each to have run the same distance.

The degree of accuracy which this result implied will be perhaps better understood by quoting the statement of Professor Airy. When writing on the subject, and expressing his satisfaction at the manner in which the officers charged with the astronomical operations, had performed their parts, he said that the error was so small, that it was less than the loss of one beat of a half second chronometer; that is, that during the circuit of astronomical stations and the interchange of chronometers, which had taken place in order to obtain the comparative longitude between the extremities of the South-West Line, of which a description has been given, there had not occurred the loss of one whole beat of a chronometer constructed to beat half seconds.

The error being ascertained, it was necessary to correct it; and this was done by running offsets at certain points along each line of lengths proportional with their distances from the extremities. The corrected line was then run through the points fixed by the offsets; and afterwards parties were put on to open it to thirty feet.

During the progress of the operations just described, the snow, which had been from four to five feet deep, had gradually melted, entailing thereby great difficulties. By degrees the snow shoes became useless, and yet without them the men sank the full depth of their legs into moist, half-melted snow, excessively difficult to get through. Add to this, the streams became rivers, and the rivers deep torrents. As an example of the labour of pushing through the snow in its moistened state, whilst it was still deep, one party was four days going ten miles.

1844

South Line.

Astronomical
Operations.

The next operations in the Valley of the St. John were to determine the parallel of latitude $46^{\circ} 25'$ on the South-West Branch, and then to run the South Line.

The further astronomical operations of 1844 were to connect the North-West Branch with Quebec.

A high hill rose above Lake Ishæganalshegeck, which was made an astronomical station, and was connected by triangulation with the Boundary point on the North-West Branch. Then a hill was sought out upon the highest ridge intervening between the Valley of the St. Lawrence and the Valley of the St. John in the direction of Quebec. Having found a spot, the tops of the trees on which could be seen both from the station on the hill above Lake Ishæganalshegeck and from the observatory which was established on the Plains of Abraham, near the citadel of Quebec, flashes of gunpowder were fired from it. These being seen, and the times noted at each of the two astronomical stations, the difference of longitude was obtained.

Highlands.

Highlands.

Turning now to other operations of the season, the attention is directed to the Highlands stretching from the source of the south-west branch of the St. John to the source of Hall's Stream, along which portion the Boundary was directed to follow the dividing ridge of the waters. The whole of that district, embracing about 180 miles in length, was forest; there was but one road through it, and that led almost due south from Quebec towards Boston in the United States.

The method adopted for finding the dividing ridge of the waters, as well as for obtaining the means of mapping it down afterwards, was this:

Setting out from the height of land on the Kennebec Road, guide-lines, as they were called, were cut through the wood, one eastward and another westward, and as nearly as could be guessed, in the general direction of the dividing ridge. From these guide-lines offsets at distances of about half-a-mile, were run over the dividing ridge; leaving water flowing, say, into the St. Lawrence, they were made to cross over the hills, and were prolonged until they struck water flowing in the opposite direction, through the Valley of the Kennebec. The highest point between those waters flowing in opposite directions would be, as a general rule, on the dividing ridge; and thus a succession of summits was obtained, which, when connected, formed the Boundary required by the Treaty. In order to connect those summits, the practice pursued was to send a man to blow a horn at one summit, which, being heard at the next, afforded a guide to a party, which, following the highest ground about them through all its different windings, listened to the blowing of the horn, and inclined that way whenever the ground admitted of their doing so; and thus they blazed a line from one summit to the other. The direction of the guide-lines was altered whenever it was deemed necessary; but both the guide-lines and the offsets being chained, and their angles of direction observed, they afforded base lines by which to correct the traverse along the actual Boundary. Another correction was also resorted to, viz., bearings of high conspicuous points, which discovered themselves as the work went on.

The line along the dividing ridge having been blazed, it was cut out to the established width of thirty feet; to accomplish which in the shortest time, large parties were employed. The guide-lines and offsets very much facilitated the operation, by enabling different working parties to get in upon the Boundary at several points at once, without interruption to each other.

The principal difficulty was the keeping up a supply of provisions to the working parties. The labour of carrying them on men's backs into the woods to such great distances as forty miles, which was the case when the cutting of the Boundary had made some progress, was very great, so great that a constant supply of fresh men was required for the purpose; for it always happened that many of the men who had made one trip into the woods with a load on their backs, refused, upon their return, to undertake another.

The heat, the rain, the difficulties of the paths,—sometimes very

"steep, and sometimes very marshy,—the snow afterwards, as the season advanced, and the insufficient shelter, combined to discourage them, and to make it necessary to arrange for a constant succession of fresh men to be sent up from distant settlements.

To complete the putting of the Boundary up to the source of Hall's Stream was a race against the season; and the snow was already two feet deep before it was accomplished. It was finished, however, before the parties left the woods; and thus the amount of Boundary cut during the season was from the outlet of Lake Pohenagamook to the source of Hall's Stream, a distance of about 264 miles, of which the British Commission had cut 224 miles. This was a larger portion of the work than properly would have fallen to the share of the British Commission, had it not been agreed between the Commissioners, for the sake of expedition, that the principal part of the cutting during this season should be done by the British Commission, whilst all that should remain to be cut of the Boundary from the source of Hall's Stream, to the end should be accomplished by the American Commission afterwards.

During the winter of 1844-45 the iron monuments were carried to their places all along that portion of the Boundary which had been cut during the season as above mentioned.

Along the South-West and South Lines, as well as up the south-west branch of the St. John to its source, they were hauled on sleighs drawn by horses, but along the Highlands that was impossible; and therefore a party of eighty Canadians, under a confidential and very determined foreman, was employed for the purpose, prepared with hand-sleighs, called by the Indians "tabaugens," but of a strong description.

They entered the woods in January, near Hall's Stream; deposited the monuments at certain points along the Boundary; and came out at the height of land on the Kennebec Road. The service was one of severe labour and exposure. Sometimes all hands were required to haul each monument in succession up a precipice; sometimes a violent snow-storm would cross the hills where the men were at work, and they would scarce be able to keep body and soul together.

The season of winter was also employed to survey on the ice the south-west branch of the St. John, the South Branch, the North-West Branch, the Matawaquam, the main St. John down as far as the St. Francis, the Great and Little Black Rivers, and the Ktjemquospem.

When the working season of 1845 began, the monuments which had been laid down at the places destined for them were erected along the south-west and south lines, also along the Highlands. The traverse of those portions of the Boundary was likewise completed. Hall's Stream was surveyed; and the 45th parallel was explored, cut out, and surveyed.

The astronomical observations were also continued between Quebec and the 45th parallel; and as Quebec had been previously connected with the north-west branch of the St. John, it followed that a complete chain of astronomical observations had been determined, extending from the Grand Falls of the St. John through the Valley of the St. John, and over to the 45th parallel, by Quebec and Montreal.

Hall's Stream was surveyed by running a guide-line from its intersection by the West Line, that is, by the Line of Valentine and Collins, in a northerly direction, then by running offsets from that guide-line to the river, and by a traverse along the stream itself.

West Line.

The Line of Valentine and Collins was found near Canaan Corner. The people of the country pointed it out. They showed a line of old blazes, as also a place where a post had stood near the Connecticut, about a mile further to the eastward than Hall's Stream. The old blazes were examined at different places along the Line between Hall's Stream and St. Regis, and were found to date back to 1772, 3, and 4. These old blazes were traceable the whole extent of the Line, except where clearings intervened. Other old marks were likewise found, of which the most remarkable

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Astronomical observations.

Hall's Stream.

West Line.

1845

able were an old post on Province Point in Mississquoi Bay, and the foundation, in masonry, of the monument which had stood near Rouse's Point, on the left bank of the Richelieu. It had been covered over with mould by time, and no appearance of it remained on the surface of the ground, which was marshy and covered with long coarse grass; but a man of the neighbourhood remembered it, and pointed out where it stood; and there, upon digging, the square mass of masonry was discovered, the foundation of the original monument.

The Line along the 45th, the West Line, as it is designated in the report and in the maps, was found to be exceedingly crooked; therefore in marking it the same method was adopted for correcting its deviations, as had been resorted to on the North Line, by a succession of straight lines kept within the cutting of thirty feet.

Wherever clearings occurred, the Line was made to run straight across them, from authentic marks on the one side to authentic marks on the other side of the same clearing.

Astronomical
operations.

The astronomical operations for the season were, in detail, as follows:—

Montreal was connected with Quebec, and St. Regis and Rouse's Point with Montreal, by interchanges of chronometers, for which the steamers on the rivers afforded great facility; then St. Regis was connected with Rouse's Point by signals of flashes, as the North-West Branch had been with Quebec. A high hill, called Lion Hill, served as the signal station.

Richford and Lake Memphramagog were likewise connected with Rouse's Point by signals from Jay Mountain in Vermont.

Afterwards the intersection of Hall's Stream by the West Line was connected with Lake Memphramagog by interchanges of chronometers. Added to these, Rouse's Point was connected with the observatory at Cambridge, near Boston, also by interchanges of chronometers.

It has been stated in the early part of this narrative, that monuments of a smaller size were erected along the Boundary, and others of a larger size at only certain points. The following is a list of the places where the larger monuments were erected, viz.:—

The source of the River St. Croix.

The intersection of the River St. John by the North Line.

The outlet of Lake Pohenagamook.

The Boundary Point on the North-West Branch.

On the left bank of the South-West Branch, at its first intersection by the South Line.

On the left bank of the South-West Branch, at its intersection by the parallel of latitude $46^{\circ} 25'$.

At the first point on the Highlands near the source of the South-West Branch.

On the east side of the Kennebec Road.

At the source of Hall's Stream.

The intersection of Hall's Stream by the West Line, on the right bank.

The intersection of the River Richelieu by the West Line, one monument on the right bank and another on the left.

The intersection of the St. Lawrence by the West Line, near St. Regis.

The foregoing narrative explains the process by which the Line of Boundary was explored, and traced, and marked, and surveyed, throughout its whole length.

It is possible that it might be useful to know precisely what portions of the work were done by American Commissioners and what by the British.

The following then is an account of those proportions:—

North Line.

The exploration was made by a party from each Commission. The cutting was divided: that portion of the Line which was south of Presqu'isle River was cut by the Americans; and that portion which was

north of that river was cut by the British. The survey was executed by a party from each Commission, who also erected the monuments.

River St. John.

The survey was made by two parties from each Commission, acting in pairs; one of each Commission surveying in company.

St. Francis.

The survey was made by a party from each Commission.

South-West Line.

The tracing and marking of this Line was executed by the British Commission alone; but the work was examined and verified afterwards by the American Commission.

South Line.

The same as on the South-West Line.

South-West Branch of the St. John.

The survey was made by the American Commission, verified and marked by the British.

Highlands.

From the source of the South-West Branch to the Kennebec Road the dividing ridge was sought out, and a succession of summits fixed, by a party from each Commission. The cutting of the Boundary was done by the American Commission; and the survey afterwards was made by a party from each Commission, but not acting together.

The erecting of the monuments was performed by the British Commission.

From the Kennebec Road to the source of Hall's Stream the dividing ridge was sought out and summits fixed by the British Commission, but it was verified afterwards by the American Commission; and a chain of summits was also erected by it.

The cutting of that portion of the Boundary was executed by the British Commission.

The survey was made by both Commissions; but their parties did not act together.

The hauling of the monuments to their places during the winter was performed by the British Commission from Hall's Stream to the Kennebec Road, and from thence to the source of the South-West Branch by the American Commission.

The erecting the monuments afterwards was done in part by the British and in part by the American Commission.

Hall's Stream.

The survey was by a party from each Commission, acting together. The marking was undertaken by the American Commission.

West Line.

The exploration was done by the American Commission, verified by the British.

The cutting of the Boundary was executed by the Americans alone.

The survey was made by each Commission, but not acting in company.

Appended to this narrative will be found reports from Captain, now Major Robinson, and the late Captain Pipou, to the British Commissioner, relating to the astronomical operations entrusted to them, which have been already mentioned in the foregoing narrative; but they will be found more in detail in the accompanying reports.

(Signed)

J. B. BUCKNALL ESTCOURT, Lt.-Col.,
Estcourt, December 31, 1847.

H. M. Commissioner.

*Report of Captain Robinson to Lieutenant-Colonel Bucknall Estcourt.**Washington, United States, July 7, 1846.*

I ANNEX to Captain Pipon's report a statement of the rates of those chronometers which were under my particular charge, with some remarks on our proceedings generally; and also some observations and results of signals which were made for the determination of differences of longitude between my station at Lake Memphramagog, and those of Major Graham, of the United States' Topographical Engineers, at Rouse's Point, and Lieutenant Thom of the same corps, stationed at Richford.

The chronometers supplied to us from Greenwich consisted of four box chronometers, regulated to sidereal time, and seven pocket chronometers, regulated to mean time.

From Greenwich to Liverpool they were conveyed by railway, and from Liverpool to the Grand Falls, in New Brunswick, where our operations on the Boundary Line commenced, they were conveyed by water, the only exceptions being the short land-carriages from the ship to the hotel, and thence to the next vessel or boat by which the party was to proceed. No accident or any rough travelling occurred to affect them on their journey.

At the Grand Falls an equal partition of them was made, as under:—

Captain Robinson.			Captain Pipon.		
Box chronometer	No. 2277, by Parkin-on and	Box chronometer	No. 341, by Arnold.		
	Frodsham.		2, Frodsham.		
	51, Heyes.	Pocket chronometer	3148, Molyneux.		
Pocket chronometer,	3147, Molyneux.	" "	3226, "		
" "	3091, "	" "	3227, "		
" "	2187, Arnold.				

The seventh pocket chronometer, No. 2111, stopped frequently at the winding-up, however carefully done; it could not be depended on, and was therefore never made use of in any of our calculations.

Our instruments were two portable transits of thirty inches focal length; a third of smaller size; two altitude and azimuth instruments, one of 15-inch, the other of 12-inch verticle circles; two mountain barometers (by Simms), and six French or Gay Lussac barometers, with other minor instruments, such as sextants, azimuth compasses, &c. These were pretty equally divided between the two astronomical parties.

There was also one large telescope of 42-inch focal length, for observing occultations, eclipses of Jupiter's satellites, &c., which was transferable between us as occasion required.

The duties which devolved upon Captain Pipon and myself were to determine the latitudes and longitudes of as many points along the Boundary Line as might be necessary to make a correct map of it, and to serve as points between which the surveyors could adjust and adapt their surveys.

A triangulation along the Boundary was quite impossible.

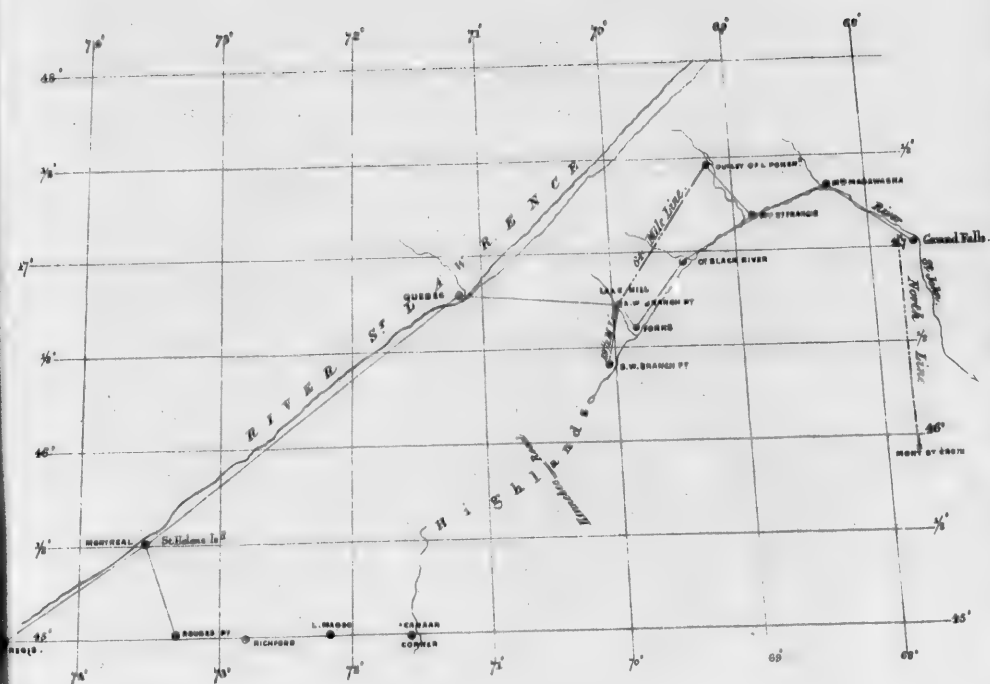
Another and principal object was to determine the directions, and run two straight lines of boundary, one of sixty-four miles long, the other of about twenty, between certain given points which had been fixed upon by the Treaty of Washington.

Owing to the impracticable nature of the country, this could only be done by ascertaining very accurately the latitudes and difference of longitude of the points, and then calculating their bearings with the meridian.

The plan of operations adopted to obtain these objects was for us to take up stations at short distances apart, between which a communication could be obtained within a moderately short period of time, not exceeding two to three days, and during which the rates of the pocket chronometers could be trusted while travelling from one standard to the other. The difference of longitude between every station was thus determined by interchanges of chronometers, or in some cases by signals. The latitude was at the same time determined by observing altitudes of stars when on and near the meridian.

Commencing at the Grand Falls near the eastern limit of the Boundary in New Brunswick and proceeding westward, a chain of stations was formed from it to St. Regis, the western extremity of the Boundary Line, connecting the whole in longitude from one end to the other,—a line of boundary of some 600 miles in extent

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The parties reached the Grand Falls in June 1843, and Captain Pipon proceeded immediately to the mouth of the Madawaska River, and established his first station at a distance up the River St. John of about forty miles from the lower station at the Grand Falls.

A transit instrument was set up at each station, and observations for time were commenced on the 1st of July. The communication was by water; each party had three boats and six boatmen attached to it. As soon as possible after obtaining a good night's observations, the pocket chronometers were compared with the standard chronometer, and sent off to be compared with the standard at the other station, and then immediately returned to be again compared with the first standard.

Three transmissions in this way of each officer's set of pocket chronometers from any two stations, were generally deemed sufficient to give a good difference of longitude between them.

When the difference of longitude between the Grand Falls and the mouth of the Madawaska was considered to be satisfactorily determined, the party at the Grand Falls moved up the river, passed Captain Pipon's station, and took up a position at the mouth of the River St. Francis, some forty miles distant from it.

The River St. John along the course we had to follow is full of shallows and rapids, and the ascent against the stream is laborious and slow. The distances, therefore, at which our stations were taken up, were necessarily at short distances from each other. The average distance the first season was forty miles, and it sometimes took us as much as sixty hours to perform even so short a journey as this. The same number of interchanges, viz., three each, were made between the St. Francis and the mouth of the Madawaska. Captain Pipon then passed up the River St. Francis, and took up his station at the outlet of the Lake Pohenagamook, at the point where the Boundary was to quit the line of the river, and take a direct course across the country of sixty-four miles, to a point on the north-west branch of the River St. John.

Interchanges were made between the mouth of the St. Francis station and the outlet of the lake, in the same way as at the other stations.

To communicate from one end of the sixty-four mile to the other end, across the country, was quite impracticable; and to obtain the difference of longitude between the extremities of this line, it was necessary to take up two intermediate stations on the St. John.

Captain Pipon therefore moved from the outlet of the Lake Pohenagamook, passed down the St. Francis and up the St. John, establishing himself at the mouth of the Great Black River. The usual interchanges were made between this and the St. Francis; and the party at the latter moved up to a station near the Forks of the St. John, at the southern extremity of a line which had been cut through the woods by one of the surveying parties, to establish the point on the North-West Branch, which by the Treaty was to be ten miles distant in the nearest direction from the main River St. John.

Up to this period all the chronometers had gone well, and the results obtained from them appeared quite satisfactory. At the end of October a great change in the temperature took place. The party moving up to the Forks had to break their way in some places through ice. Snow fell and remained on the ground, and all communication for some time was cut off with the party at Black River.

During the months of November, December, and January, the cold was intense. The thermometers brought from England would only register to -19° of Fahrenheit. The column of mercury was frequently all in the bulb, and the degree of cold must have been very much greater than -19° . Judging from reports of its intensity in other portions of Canada where it was registered, it must have been at times beyond -30° .

The chronometers during this time were kept in a log-hut, in which a stove was necessarily used. They were placed in a deal box, packed round with sawdust, and the box itself wrapped up in a large blanket, to keep the temperature as even as possible. In the day-time the room was kept at a temperature of 60° of Fahrenheit, whilst at night, when the stove could not be prevented from going out, the temperature would sink to very

nearly the -19° point. This great and sudden range of temperature was necessarily very trying, and affected them sensibly. The standard No. 2277 once stopped at the winding-up for 1m. 16.5s., which it had never done before. And its average rate increased from 0.40s. to 2.63s. During the expedition, both before and after these months, this chronometer performed very well.

No. 51, Heves, rate increased largely, from -4.82 s. to -7.17 s. At other times its rate was tolerably constant, though large; on which account, and because it beat 130 times to the minute, the first opportunity (which occurred in the following winter) was taken to send it to England, and have it exchanged for another. In the course of one night in November, three pocket chronometers stopped from the intense cold.

No. 3091 was particularly affected. Whilst kept warm it would go, but if taken into the observatory it would stop directly.

No. 2187 was moderately affected. This chronometer performed very fairly throughout.

No. 3147 was the least affected. It performed well during this winter, and very well indeed at all other times.

No. 3091 was taken to England in December 1844, and placed in the maker's hands. It improved it for a time, but its performance in 1845 was always doubtful.

In January 1844, the River St. John became frozen over throughout, and interchanges of chronometers were made with the mouth of the Black River by means of carioles,—a light kind of sleigh.

In this case there was a slight variation in the plan of interchanging. Early in November, Captain Pipon had sent up his pocket chronometers to the Forks, for a first interchange by water on the usual plan; but the river partially freezing over, the men were obliged to abandon their boat on their journey when near the Forks, and the chronometers in consequence could not be returned to him.

In making the interchanges, the pocket chronometers were all sent together from one station to the other; going and returning three times from the Forks to the Great Black River, and twice from the Great Black River to the Forks and back.

Notwithstanding the very unfavourable circumstances under which this difference of longitude was obtained,—the observations being made sometimes when the mercury had sunk into the bulb of the thermometer—the spirit in the levels of the instrument condensed so much that occasionally only one end of the bubble could be seen, and that it was painful to touch any kind of metal without gloves on,—yet the ranges were not on the whole greater, nor did the results appear less satisfactory than those made in warmer weather.

There was still a link necessary in the chain to obtain a difference of longitude and latitude between the two ends of the Sixty-four-mile Line. This was the bearing and exact distance of the North-West Branch Point from the station at the Forks. This was obtained by observation and measurement along the line mentioned as having been cut by a surveying party in the summer.

It was not until the end of January that, by this indirect and tedious course, the differences of longitude and the latitude of the two ends of the Line were determined.

From the data thus obtained, the bearing of the Line from each end was calculated. The chief object in view in thus persisting to carry on observations during the severity of a Canadian winter, was to obtain these data in time to run the Line through the woods in the spring of the year, whilst the snow was yet on the ground, and the rivers still frozen over, enabling provisions and camp equipments for the cutting parties to be carried along with greater facility than at any other time.

The beginning of March was the time decided upon to commence running the Line.

Captain Pipon, by a circuitous route, taking with him a party of labourers, went back to his former station at the outlet of the Lake Pohenagamook; made his observations to lay off the direction of the Line according to the calculation; and commenced cutting.

The party at the North-West Branch end (including Lieutenant-Colonel Estcourt and Mr. Scott, with a strong body of labourers) did the same, and commenced cutting from their side.

About four miles from the North-West Branch end, the Line passed over the shoulder of a conical-shaped hill, called the Sugar-Loaf, from which there was a good commanding view of the country for many miles in the direction the Line was to take.

The transit instrument was removed from the North-West Branch to an elevated stand and platform made for it on this shoulder of the hill. At the starting point a light was burnt nightly; the transit instrument was set upon it; and being then turned on its axes, the true-direction of the Line in continuation was easily and accurately ascertained. The party, for the sake of convenience, encamped not far from the instrument stand, the snow on the ground being at the time everywhere about four feet deep. Mr. Scott, with a strong body of labourers—for was necessary to cut away for themselves through the dense forest, and to carry provisions—set off from Sugar-Loaf Hill to the first succeeding ridge, about four miles distant, which having reached, he halted and waited until night; when, by signals previously agreed upon, the point on the hill where the Line passed was marked, a clearing made round it, and a pole set up. After doing which, he set off for the next succeeding ridge, upon which a view back of the Sugar-Loaf Hill could be obtained, steering and cutting his way across the valleys as well as he could by the compass.

The plan of getting into line was thus: having arrived on a ridge, from which the Sugar-Loaf (a very conspicuous object) could be seen, a torch-light made of the bark of the birch-tree was burnt as soon as it was dark. A torch made of this bark gives a most powerful light, which could be distinguished easily at the greatest distance we had occasion to use them—this was about thirty-eight miles. As soon as the torch was seen from the transit-stand, the instrument was levelled, turned upon the light burning at the starting point, and then reversed in the direction of the cutting party, when it was at once seen how much they had got out of the right line.

The signals employed were flashes of gunpowder, the quantity used varying from two charges of a fowling-piece up to seven or eight per flash, according to the distance.

The instrument being levelled and ready, four flashes were fired in quick succession, to denote the same to the cutting party.

This being answered by an equal number from them, denoting their readiness also, the signalling was continued—

One flash—move north.

Two flashes—move south.

Three flashes—wait awhile.

Four flashes—the torch is in the line. Proceed on to the next station.

To prevent mistakes, and keeping one party waiting unnecessarily for the other, it was customary to acknowledge every signal made, immediately, by a corresponding signal.

Flashes by gunpowder fired at night are very effective signals, far superior to rockets. They are instantaneous, and can be seen at very great distances. At forty miles they were seen distinctly, whilst rockets were made out with difficulty, and sometimes not at all. When a point in the Line was determined, clearings were made round it, and a cutting made towards the Sugar-Loaf Hill, and continued some way in the contrary direction. These formed notches or gaps, which were conspicuous in the day-time, and served as a guide to the cutting party to take up their next position pretty accurately. Heliostats by day were also used for keeping the Line. Proceeding in this way, points in the Line, crossing ridges of hills, were marked at eight several places, the last being about thirty-eight miles distant from the transit instrument at the Sugar-Loaf. The ground beyond this, on the other part of the Line, was very unfavourable for the Pohenagameok party, affording no commanding station, and the transit had to be moved from station to station.

It was not until the end of five weeks, during which time the two

cutting parties had been constantly approaching each other, that any intelligence or symptoms of their contiguity were obtained.

At the end of this time, the North-West Branch party, cutting their way onward, descried trees falling upon the ridge to which they were advancing, and gradually a notch or gap appeared. This was the Pohen-agamook party, and apparently right in the place for which the others were making.

The direction of each line was however continued until they came abreast of each other, when the distance from one to the other was measured, and found to be 341 feet;—an amount equal to what would be produced by about one-quarter second of time error in the determination of the difference of longitude of the two extremities of the Line.

Each party as they proceeded cutting their way measured as well as they could the distances they had advanced, and of those points at which marks in the Line had been set up. This 341 feet was divided proportionally according to the distance each party had made from their starting points. A high pole or staff was erected at the spot thus given, and the two cutting parties, turning their backs upon each other, set off on their return back to their original stations.

At each former point, where a mark had been set up, an offset was measured from it, proportionally to its distance on the Line, a place cleared for it, and a new pole prepared to be set up to mark where the correct Line should pass. The transit instrument on the Sugar Loaf, four miles distant from the North-West Branch end was shifted its proportional distance also, and as the cutting party returned homewards, signalled them at night into line on each succeeding ridge. The cutting of this line commenced about March 10, 1844. The parties came in sight of each other for the first time on the 17th of April following, and the distance between the two lines, when abreast of each other, was measured about the 20th of April, making a period of forty-one days' cutting from the starting points. At the commencement the snow was four feet on the ground, and the rivers everywhere frozen over; but before it was concluded, the snow had begun to melt away, and the rivers were running in torrents. Great difficulty was found in keeping up the communications and supplies of provisions. Carrying loads through the woods: under favourable circumstances the men could not make more on an average than eight to ten miles a-day. At one period on this line a party of labourers sent with provisions, could not make more than four to five miles through the soft and melting snow, in which snow-shoes were worse than useless.

Further operations were pretty much suspended until the beginning of June, when strong parties of labourers, directed by non-commissioned officers of the Sappers and Miners, were set to cut out the whole line thirty feet wide, clearing a way in the centre, of about eight feet wide, but leaving the other part with the stumps breast-high, and the trees as they had fallen. These parties were guided in their cuttings by the marks which had been set up on the ridges at no very great distances apart from each other. When the line had been thus cut out from end to end, a transit instrument was sent through it, adjusting correctly all the station-poles, and ensuring the straightness of the line beyond all doubt.

This having been finally accomplished, the next proceeding of the astronomical parties was to run another straight line, but of shorter length (being not quite twenty miles), between the North-West Branch station and a point on the South-West Branch of the River St. John, where the stream was intersected by the parallel of $46^{\circ} 25'$ of north latitude.

In June Captain Pipon proceeded up the South-West Branch, and after one or two trial latitudes, took up a position within a few seconds of the true point, which was afterwards determined from it accurately by measurement.

Interchanges of chronometers were made in the usual way between this station and that at the North-West Branch end.

The communication (though rather circuitous by water) was made from end to end direct, that is, without any intermediate station. Three trips of the chronometers were made each way. With the difference of

longitude thus determined, and the absolute latitudes, the direction of the Line from each station was computed, and it was proceeded with to be cut and run much in the same way as the longer line had been.

It was not however quite so successfully done, the lines proving, when they were abreast of each other, to be 576 feet apart,—a quantity denoting an error of one-half second of time in the determination of the difference of longitude of the two extremities.

As this had been obtained so much more directly than in the preceding case, too much confidence was placed in the result given by the trips of the chronometers, and it would have been better had a greater number of them taken place. This error was divided proportionally to the distances each party had cut from their starting points; the marks set up at the intermediate stations shifted; the line adjusted, cut out thirty feet wide with eight feet clear in the centre, and was finally tested by sending a transit instrument through from end to end.

At the beginning of September 1844, these operations were all completed, and the next step in the order of proceedings, was to obtain a difference of longitude between the station at the North-West Branch and Quebec. The actual distance in a straight line from one to the other was something more than sixty miles. The communication was by land, and the road of the worst description for the transmission of chronometers: they could not escape being very much shaken; the time of absence on their journey to and fro would necessarily be of some duration; and any very accurate result by the usual plan of interchanges could scarcely be expected. Signals from an intermediate hill were therefore adopted. At all times the latter plan is the simplest and most accurate way of determining a difference of longitude, and would have been adopted before, had any opportunity of doing so presented itself. From the top of a hill a little more than a mile distant from the North-West Branch station, a range of hills could be seen about twenty miles off, in the direction of Quebec. This it was conjectured, and rightly, would be seen also from Quebec.

Captain Pipon and his party, therefore, leaving the woods, proceeded to Quebec, and established his transit instrument at a station on the plains of Abraham, from whence there was the best view in the required direction. The transit instrument at the North-West Branch, and chronometers, were removed to the Lake Hill station. Serjeant McGuckin, of the Royal Sappers and Miners, with a party of labourers to assist him, was sent to one of the most conspicuous hills on the range, taking with him a tent, provisions, a supply of gunpowder, rockets, pulleys, rope, &c. This whole range was covered to the summit with a dense mass of forest.

From the Lake Hill a heliostat was kept at times reflecting to the hill selected, as a guide to Serjeant McGuckin in choosing the right one. Having arrived at the hill, and ascertained by climbing, that he could see back to the Lake Hill, and forward in the direction of Quebec, the labourers were set to work to make a clearing on the top, leaving one tree in the centre, from which the flashes were to be fired. These were thus managed:—

The leaves and branches of the tree which were in the way were cut off; a small pulley, with an endless rope through it and reaching to the ground, was attached to one of the top branches; a piece of tin was rolled up so as to form a small conical cup, and attached with wire to the endless rope; the charge, varying from a quarter to a half of a pound of gunpowder, was wrapped in a piece of paper and placed in the tin cup, with a certain length of touch-paper hanging out of it. The end of this being lighted, the tin cup was hoisted quickly by the rope to the top of the tree, where the charge exploded, and the cup was hauled down again. Serjeant McGuckin had a pocket chronometer with him, by which he was directed to fire his charges, at ten-minute intervals, between 8 and 10 o'clock every evening, after it was known that the Quebec party were ready to commence observations.

As soon as this was known at the Lake Hill, a signal to that effect was made to him, and the flashing commenced.

Previous to commencing with the flashes, two rockets were fired from

the hill, and at the termination one or two more. It was found difficult to note the precise moment of their bursting; some were not seen, and no use was made of them in the calculations.

Transits of stars were observed for time on the same night that the signals were made, and the ten-minute intervals allowed it to be done with but little interruption from them.

On the night of the 23rd September (the first night), out of thirteen fired, ten flashes were observed and noted by both parties. From Quebec the distance must have been fully forty miles, yet they were distinctly visible, even to the naked eye. The signals were repeated on five subsequent nights, with various success as to the numbers noted in common.

Some of the nights the wind blew strong, and the charges exploded before reaching the top of the tree. In the course of six nights forty-six observations in common were observed, and this number was deemed sufficient to give a good difference of longitude. Compared with what was obtained afterwards between other stations, the ranges on this occasion were great, but at that time they were thought by us very good. The observatory tent on the Lake Hill was much exposed, and the lights were not so well protected from the high winds as could have been desired, and had some effect, no doubt, on producing the high ranges. When the signalling was over, the experiment was tried of sending the pocket chronometers for one trip, from the Lake Hill to Quebec and back. The time on their journey was four days and eight hours; the road travelled of the worst description. For more than half the journey they were carried by a man on foot, the other portion in a cariole. The mean of the three chronometers thus sent, gave a result differing by two and a half seconds of time from that obtained by the flashes. The same was tried by one interchange from Quebec to the Lake Hill and back, but that proved an entire failure, and no more trials were made.

On the 21st October the Lake Hill party left the woods with the intention of proceeding to Montreal and forming a station there, to be connected with that at Quebec by the usual interchanges of chronometers.

Passing out of the woods by the way of St. Thomas', the party arrived at Montreal on the last day of October.

Winter had now commenced; the ground was covered with snow, rendering it difficult to select a good spot on which to set up the instruments, and as the navigation between Montreal and Quebec generally closes in the month of November, it was not probable that the two stations could be connected before the communication was broken up. The field operations for the year 1844, so far as the astronomical parties were concerned, were therefore terminated.

At Quebec, however, where a good and substantial observatory had been set up, observations for absolute longitude by lunar transits and moon culminating stars, continued to be made through the winter, whenever opportunities offered.

From June 1843 to the end of October 1844, the astronomical parties had been engaged, with only the intermission of part of the month of February and part of the month of May, in the constant prosecution of their particular duties. From the impracticable nature of the country, the bad communications, and the necessarily rough means of transport by small boats and canoes on the rivers, and men's backs in the woods, some damages and breakages could not be prevented to our instruments.

One mountain barometer and three of the smaller (Gay Lussac) barometers were by this time broken.

One of the box chronometers (51 Heyes) had suffered, and it was desirable to exchange it for another. No. 3091 pocket chronometer had failed entirely about this time. An improvement in one of the transit instruments was desirable, and some other repairs to the smaller instruments were required. There were no means of effecting these in this country.

The winter afforded a favourable opportunity of getting all set to rights again and ready for the next year's operations; and having obtained leave, they were taken to England by me in December 1844, and

brought back to Montreal in time for the recommencement of observations at the first opening of the navigation of the St. Lawrence.

This was the 28th of April, 1845.

Pursuing the plan of operations, of connecting the eastern with the western termination of the Boundary, by a chain of stations at moderate intervals apart from each other, a site was selected on St. Helen's Island, opposite the city of Montreal. Two stone pillars, standing upon good foundations, had in the course of April been prepared for the instruments, and observations and interchanges of chronometers with Quebec were immediately commenced.

The distance between these two stations is the greatest in our chain; but the communication by the large steam-boats running on the St. Lawrence rendered it the easiest and the interval in time among the shortest.

Four interchanges were made by each party; the results appeared very satisfactory, agreeing closer together than they did on any other occasion.

The mean difference of longitude by four sets of Captain	s. m.
Pipon's chronometers, was	9 17-80
Do. four sets of Captain Robinson's, was	9 17-67
Difference	0 0-13

The distance was the greatest, the time of absence was the same as some of the others; but the transport or carriage of the chronometers was the easiest of all the stations.

These interchanges occupied the month of May. The Quebec party then moved up to St. Regis, the western termination of the Boundary.

During the interval of establishing the observatory there, the opportunity was taken of making interchanges with Major Graham of the United States' Topographical Engineers, who had taken up a position (for astronomical observations) on the Boundary at Rouse's Point on Lake Champlain. Three trips of chronometers were made from St. Helen's to Rouse's Point and back, and four of Major Graham's from Rouse's Point to St. Helen's and back.

The St. Regis party being by this time ready, interchanges between it and St. Helen's commenced, four journeys of the chronometers each way were made in the usual manner.

This completed the junction of the Grand Falls by differences of longitudes with St. Regis.

There appearing a very favourable hill for connecting St. Regis with Rouse's Point by signals, it was suggested by Captain Pipon to do so, and carried into effect very successfully.

By observations made on five nights, during which eighty-two flashes were observed in common, the difference in longitude was made to be

By transmission of chronometers between St. Helen's and St. Regis, and St. Helen's and Rouse's Point, the difference of longitude was made to be

Difference 0 0-12

A difference of only twelve-hundredths of a second of time, showing how very accurately the transmission of chronometers would give a difference of longitude when the communications were easy.

In July the party at St. Helen's broke up and moved to a point on the Boundary Line where it crossed the Lake Memphramagog on its eastern shore, the object being to determine its latitude and the difference of longitude between it and Rouse's Point.

A high mountain in Vermont, called Jay Peak, situated intermediately and a little to the south of the Line, afforded a very favourable opportunity of connecting the stations by signals. The distance between the two stations was in a straight line about fifty-six miles.

Corporal Forbes of the Royal Sappers and Miners was sent with a party of labourers, and encamped near the top of the hill from which the signals were to be made.

The hill was high and bare of wood at its summit; no clearing or especial contrivance was necessary. He was supplied with a chronometer watch to regulate his times of firing.

The charges varied from a quarter to one-third of a pound of gunpowder, fired from the surface of a piece of flat board. At first the intervals between the flashes were fired at ten minutes, beginning at 9 and ending at 11 p. m., but were changed to three-minute intervals, and fired between half-past 8 and half-past 9 p. m.; and the observations for time (which it was always desirable to have on the same evening) were made when the signalling was over.

The flashes were fired only on fine nights, and could be distinctly seen from both stations. In the course of six nights' signals, eighty flashes were observed in common.

Corporal Forbes's party was relieved on the 19th of August, and was succeeded by an American party, who continued the signals in the same manner; but the interval between the flashes was reduced to about two minutes, and the time of signalling to between 8 and 9 p. m.

Whilst the signalling was in progress between the station at Lake Memphramagog and Rouse's Point, Lieutenant Thom, of the United States' Topographical Engineers, took up a station for astronomical observations, on the Boundary at Richford, about twenty-four miles distant from Lake Memphramagog and thirty-two miles from Rouse's Point.

The Jay Peak could be seen from his station, and the signals made from it answered for the three parties.

In the course of six nights' observations, ninety-five flashes were observed in common with Richford, and the difference of longitude obtained by the whole, was 1m. 53.72s.

	M.	S.
The highest result of any one night's observations, was	1	54.11
The lowest	1	53.33

The range 0 0.78

Between Lake Memphramagog and Rouse's Point, by eighty flashes and six nights' observations, the difference of longitude was made 4m. 35.08s.

	M.	S.
The highest result of any one night's observations, was	4	35.55
The lowest	4	34.50

The range 0 01.05

Between St. Regis and Rouse's Point, the mean of eighty-two flashes observed on five nights, gave a difference of longitude of 5m. 13.24s.

	M.	S.
The highest result of any one night's observations, was	5	13.64
The lowest	5	12.75

The range 0 0.89

For the sake of experiment, and testing the result by transmissions of chronometers, one trip was made from Lake Memphramagog to Rouse's Point and back, and one to Richford and back.

	M.	S.
By the signals, Rouse's Point was west	4	35.08
One trip of three pocket chronometers gave it	4	35.55

Difference 0 0.47

By signals, Richford was west	1	53.72
One trip, three pocket chronometers gave it	1	54.65

Difference 0.93

These results agreeing so well were considered highly satisfactory.

From the commencement of observations at the Grand Falls, to their conclusion at Lake Memphramagog, observations for absolute longitude

by lunar transits and moon culminating stars were made at every station, whenever a favourable opportunity offered. Thirty-nine lunar transits were obtained at Quebec alone; thirty-nine were obtained at the stations east of Quebec; and twenty-one at stations west of Quebec: in all ninety-nine observations.

These have all been corrected for lunar errors by data received from Greenwich.

Referring them all by means of the ascertained differences of longitude to the one station at Quebec, an absolute longitude for Quebec has been derived from a mean of ninety-nine observations of transits of the moon's bright limb.

The result given by them is, that the longitude of the astronomical station at Quebec is 4h. 44m. 42s. west from Greenwich. From this and the known differences of longitude between it and each of the other stations, their absolute longitudes are determined and given in the accompanying abstract.

This result for Quebec differs by several seconds from the determinations of other observers, and it will be advisable, therefore, on our return to England, to have the calculations all carefully examined or recalculated.

It may then probably become necessary to add a certain fixed quantity to each of the determinations given in the abstract.

The observations at Lake Memphramagog occupied all August and part of September 1845. It was next intended that Major Graham should connect a station at Canaan Corner (the eastern extremity of the Boundary following the 45th parallel of latitude) with the Lake Memphramagog; but being detained longer than was expected at Rouse's Point, the intention was not carried out.

This terminated the astronomical observations and labours in the field of the officers on the British Commission. The party broke up and moved from Lake Memphramagog early in October 1845, and proceeded to join the other members of the Commission, who had preceded them to Washington in the United States, where the time since has been occupied in examining the observations, revising the calculations, and in making out fair copies of the whole, to accompany the plans and reports of the Commissioners.

(Signed) WM. ROBINSON, Capt., R.E.

Note.—The observations and calculations for the absolute longitudes were, upon the return of the Commission to England, submitted for the examination and opinion of Mr. Airy, the Astronomer Royal at Greenwich, who, after a careful consideration and a recalculation of the lunar transits, with every improved data that could be supplied by the Observatory at Greenwich, determined the result of the absolute longitude of the Astronomical station at Quebec, to be 4h. 44m. 43.91s. west; therefore a correction of 1.91s. of time, or 28.65s. of arc must be added to every absolute longitude in the General Abstract attached to this report.

London, April 11, 1847.

(Signed) WM. ROBINSON, Capt. R.E.,
Bt. Major.

Note.—It should be borne in mind, whilst considering the performances of the chronometers, as shown by the accompanying Tables, that perhaps on no expedition were chronometers more severely tried than on this of the Boundary Commission. They were necessarily kept in tents or log-huts heated by stoves; they were exposed to the extreme heat and cold of a Canadian climate; and were constantly being moved from one station to another. Whenever the opportunity offered, they were carried by water, but frequently they had journeys to make by land, and were conveyed in the carriages of the country over very bad roads, and sometimes they were carried by hand through the woods.

W. R.

Sidereal Chronometer, Parkinson and Frodsham, No. 2277 (Box Chronometer) used as standard.

STATION.	Date.	Rates.		Average or mean of Rates determined during the month.	REMARKS.
		Range during month.			
		From	To		
	1843	s.	s.	s.	
Greenwich	April	+0.1	-1.1	-0.5	On board steamer "Hibernia."
On passage out ..	April	..	..	-1.57	
Grand Falls, New Bruns- wick	July	-0.00	-2.89	-1.66	Chronometer kept in a tent.
Mouth of River St. Francis	August	-0.99	-2.50	-1.49	Kept in a hole in the ground made under the floor of the observatory.
Ditto	Sept.	-0.54	-1.82	-1.11	
Ditto	Oct.	+0.08	-0.80	-0.40	
Forks of St. John ..	Nov.	-1.24	-4.57	-2.63	A great change in the temperature, this month.
Ditto	Dec.	-1.60	-2.88	-2.28	
	1844				Subject these months to great and sudden changes of temperature, varying from 60° of Fahr. to some unknown quantity below -19°, at which point the mercury was in the bulb. On 9th January, stopped at winding up, 1m. 16.5. April, May, and June, no observations for time; engaged tracing and cutting out the 64-mile line.
Ditto	January	-0.05	-3.44	-2.17	
N. W. Branch	March	-0.58	-1.69	-0.76	
Ditto	July	+1.07	-0.30	+0.03	
Ditto	August	+0.07	+0.36	+0.21	
Ditto	Sept.	+0.33	+0.41	+0.37	
Lake Hill	Sept.	-0.46	-1.30	-0.94	
Ditto	Oct.	-0.86	-1.82	-1.27	
	1845				
St. Helen's Island, near Montreal	May	+2.38	-2.10	-0.21	
Ditto	June	+2.57	-1.95	+0.40	
Ditto	July	+2.81	-0.84	+0.41	
Lake Memphramagog ..	August	+1.40	-1.98	+0.08	Kept in a tent (under ground).
Ditto	Sept.	-0.63	-3.67	-2.16	Operations in the field; observations terminated in September 1845.

Sidereal Chronometer No. 51, Heyes (Box Chronometer).

	1843				
Greenwich	April	-5.3	-3.3	-4.0	Rated at the Royal Observatory.
Atlantic Ocean ..	April	..	..	-3.65	On board the "Hibernia" steamer.
Grand Falls, New Bruns- wick	July	-2.77	-7.50	-4.11	Observations for time commenced this month.
Mouth of River St. Francis	August	-3.74	-6.74	-4.48	Kept under ground in observatory tent.
Ditto	Sept.	-3.59	-5.82	-4.75	
Ditto	Oct.	-4.12	-5.62	-4.82	

Sidereal Chronometer No. 51.—(Continued.)

STATION.	Date.	Rates.		Average or mean of Rates determined during the month.	REMARKS.
		Range during month.			
		From	To		
	1843	s.	s.	s.	
Forks, River St. John.	Nov.	-9.60	-4.78	-6.28	Kept in a log-hut heated by stove. The variations of temperature during these three months were sudden and great; the thermometer varying from 60° during the day to some unknown quantity below—19° of Fahr. at night. February, no observations for time.
Ditto	Dec.	-8.96	-5.88	-7.17	
	1844				
Ditto	January	-9.12	-4.05	-6.88	April, May, and June, no observations for time; engaged running and cutting out the 64-mile line, &c.
N. W. Branch..	March	-6.77	-3.51	-4.77	
Ditto	July	-2.59	-5.30	-4.10	
Ditto	August	-3.43	-5.54	-4.40	
Ditto	Sept.	-3.14	-5.09	-4.38	
Lake Hill	Sept.	-5.96	-4.80	-5.32	Removed to Lake Hill, 19th September.
Ditto	Oct.	-6.10	-4.55	-5.17	Operations in the field closed for the season, October 1844.

On the 21st of October, the chronometers were taken from the Lake Hill to St. Thomas, and from thence to Quebec and Montreal. This chronometer beat 130 times to the minute; on which account, and its large rate, Captain Robinson took it to England with him in December 1844, and exchanged it for Sidereal Chronometer No. 943.

(Signed)

WM. ROBINSON,
Captain, Royal Engineers.

Chronometer No. 943, Molyneux (Sidereal Box Chronometer).

STATION.	Date.	Rates.		Average or mean of Rates determined during the month.	REMARKS.
		Range during month.			
		From	To		
	1845	s.	s.	s.	
St. Helen's Island, Mon- treal	May	+0.03	-1.45	-0.73	No. 943 was brought from England in April 1845, in exchange for 51, Heyes.
Ditto	June	-1.30	-2.56	-2.13	Used as standard chronometer for these three months.
Ditto	July	+0.13	-5.23	-3.30	In July the temperature increased considerably, and the chronometer rate increased with it.
Lake Memphramagog ..	August	-2.86	-12.01	-7.60		Kept under ground under the floor of a tent.
Ditto	Sept.	-14.10	-7.55	-10.10	The temperature during these months was very high.
				.	Operations in the field and observations terminated September 1845.

Pocket Chronometer No. 3144, by Molyneux.

STATION.	Date.	Rates.		Average or mean of Rates determined during the month.	REMARKS.
		Range during month.			
		From.	To.		
	1843	s.	s.	W.	
Royal Observatory, Greenwich	April	..	..	+1.3	
Atlantic Ocean	April	..	..	-0.14	On board steamer "Hibernia."
Grand Falls, New Brun- swick	July	+0.34	-1.16	-0.23	Travelling repeatedly from one station to another for determining difference of longitude.
Mouth, River St. Francis	August	-2.33	-1.46	-1.73	
Ditto	Sept.	-2.05	-0.02	-0.87	
Ditto	Oct.	+0.38	-3.52	-1.81	Exposed to great variations of tem- perature these months.
Forks, River St. John..	Nov.	-3.7	-1.64	-2.85	
Ditto	Dec.	-2.38	-3.14	-2.74	
	1844				
Ditto	Jan.	-1.99	+0.11	-0.86	Ditto, and travelling for difference of longitude.
N. W. Branch ..	March	-1.78	+2.04	+0.77	
Ditto	July	-0.18	-3.05	-1.06	
Ditto	August	-2.70	-0.11	-1.53	Removed to Lake Hill, 19th Sep- tember.
Ditto	Sept.	-0.43	-1.12	-0.84	
Lake Hill ..	Sept.	+0.27	+4.67	+2.63	
Ditto	Oct.	+0.17	-1.07	-0.45	
	1845				
St. Helen's Island ..	May	+2.19	-1.61	+0.51	Travelling constantly for difference of longitude.
Ditto	June	-0.44	+0.84	+0.42	Ditto.
Lake Memphramagog..	August	+1.15	-1.38	-0.30	Kept under ground under floor of tent.
Ditto	Sept.	-0.98	+2.65	+0.38	

Pocket Chronometer No. 3091, by Molyneux.

	1843				
Royal Observatory, Greenwich	April	..	..	-2.1	Removed from Greenwich, 16th April.
On passage out	April	..	..	+0.7	On board steamer "Hibernia."
New Brunswick, Grand Falls	July	+0.96	+2.26	+1.53	Travelling constantly to and fro for determining difference of longitude.
Mouth of St. Francis ..	August	+0.26	+0.80	+0.58	
Ditto	Sept.	+0.35	+1.62	+0.99	
Ditto	Oct.	+1.35	-12.14	-2.29	During these four months this watch stopped whenever exposed to the cold, and no dependence could be placed upon its rates. As long as kept warm it would go, but not otherwise.
Forks of St. John ..	Nov.	..	..	..	
Ditto	Dec.	..	..	..	
	1844				
Ditto	January	..	..	..	
N. W. Branch ..	March	..	..	..	

Pocket Chronometer No. 3091.—(Continued.)

STATION.	Date.	Rates.		Average or mean of Rates determined during the month.	REMARKS.
		Range during month.			
		From.	To.		
	1844	s.	s.	s.	
N. W. Branch	July	+ 11.09	+ 11.81	+ 11.50	
Ditto	August	+ 20.75	+ 1.74	+ 11.09	
Ditto	Sept.	+ 10.97	- 11.23	+ 11.22	Removed to Lake Hill, 19th Sep- tember.
Lake Hill	Sept.	..	..	..	Stopped several times during these two months without apparent cause. It was taken by Captain Robinson to England, in the win- ter of 1844, and placed in the maker's hands for examination.
Ditto	Oct.	..	..	..	
	1845				
St. Helen's Island ..	May	-0.23	-4.99	-2.19	
Ditto	June	-1.82	+0.72	-0.15	
Lake Memphramagog .	August	-2.91	-1.93	-2.42	
Ditto	Sept.	+0.52	-0.85	-0.09	

Pocket Chronometer No. 2187, Arnold.

	1843				
Royal Observatory, Greenwich	April	..	..	-2.4	
On passage out ..	April	..	..	-2.1	On board steamer "Hibernia."
New Brunswick, Grand Falls	July	-0.43	-1.91	-1.34	
Mouth, of St. Francis ..	August	-1.88	-0.71	-1.20	Travelling constantly to and fro for determining difference of longitude.
Ditto	Sept.	-0.92	-4.50	-2.34	
Ditto	Oct.	-3.80	-0.43	-2.42	
Forks of St. John ..	Nov.	+28.96	-3.94	+8.27	
Ditto	Dec.	-4.07	-5.90	-4.70	Kept in a log-hut warmed with stove. Temperature varying frequently from 60° in the day down to some unknown quantity below -19° Fahr. at night.
	1844				
Ditto	January	-1.87	+0.52	-0.85	February, no observations for time.
N. W. Branch ..	March	-0.86	-7.21	-2.77	
Ditto	July	+3.54	+5.30	+4.29	April, May, and June, 1844, no observations for time; engaged running and cutting out the 64 mile line, &c.
Ditto	August	+3.50	+7.08	+5.16	
Ditto	Sept.	+5.63	+6.55	+6.15	Removed to Lake Hill, 19th September.
Lake Hill ..	Sept.	+10.88	+13.57	+12.49	Operations in the field closed for the season in October 1844. Recommended May 1845.
	1845				
St. Helen's Island, Montreal	May	+10.06	-0.43	+4.65	
Ditto	June	-0.99	+3.54	+1.13	
Lake Memphramagog ..	August	-0.33	+4.29	+1.82	
Ditto	Sept.	+1.15	+4.80	+2.69	Operations in the field and observations terminated, Sept. 1845.

(Signed)

WM. ROBINSON, Captain, Royal Engineers.
H

OBSERVATIONS for Difference of Longitude between the Astronomical Station at Rouse's Point, under charge of Major J. D. Graham, United States' Topographical Engineers, and the Astronomical Station on the east shore of Lake Memphramagog, in Standstead, Canada East, under charge of Captain Robinson, Royal Engineers, made upon flashes of gunpowder fired from the top of Jay Peak, in the south-west part of the Township of Jay in the State of Vermont, August 1845.

Signals made on August 1, between 9 h. and 11 h., at 10 minutes intervals.

Name of Station.	Chrono- meters' Nos.	Flashes observed.	Errors of Chrons. on Sidl. Time of Stations.		True Sidl. Time of Observation.		Difference of Longitude.
			H. M. S.	M. S.	H. M. S.	M. S.	
Lake Memphramagog	2277	18 13 25.0	Fast	10 12.18	18 3 12.82	4 34.82	
Rouse's Point ..	2557	18 2 21.15	"	3 43.5	17 58 38.00		
Lake Memphramagog	2277	18 23 36.5	"	10 12.18	18 13 24.32	4 35.32	
Rouse's Point ..	2557	18 12 32.5	"	3 43.5	18 8 49.00		
Lake Memphramagog	2277	18 43 28.0	"	10 12.18	18 33 15.82	4 35.32	
Rouse's Point ..	2557	18 32 24.0	"	3 43.5	18 28 40.50		
Lake Memphramagog	2277	19 3 32.0	"	10 12.18	18 53 19.82	4 35.62	
Rouse's Point ..	2557	18 52 27.7	"	3 43.5	18 48 44.20		
Lake Memphramagog	2277	19 13 32.5	"	10 12.18	19 3 20.32	4 35.82	
Rouse's Point ..	2557	19 2 28.0	"	3 43.5	18 58 44.50		
Lake Memphramagog	2277	19 24 9.0	"	10 12.18	19 13 56.82	4 36.02	
Rouse's Point ..	2557	19 13 4.3	"	3 43.5	19 9 20.80		
Lake Memphramagog	2277	19 33 37.0	"	10 12.18	19 23 24.82	4 35.92	
Rouse's Point ..	2557	19 22 32.4	"	3 43.5	19 18 48.90		
Lake Memphramagog	2277	19 43 34.0	"	10 12.18	19 33 21.82	4 35.32	
Rouse's Point ..	2557	19 32 30.0	"	3 43.5	19 28 46.5		
Lake Memphramagog	2277	19 53 41.5	"	10 12.18	19 43 29.32	4 35.82	
Rouse's Point ..	2557	19 42 37.0	"	3 43.5	19 38 53.50		
						9)	49.98

Mean difference of longitude obtained on August 1 = 4 35.55

Signals made on August 3, between 8½ h. and 9½ h., at 3 minutes intervals.

Lake Memphramagog	2277	17 40 8.0	Fast 10 14.80	17 29 53.20	4 34.62		
Rouse's Point ..	2557	17 29 2.7	" 3 44.12	17 25 18.58			
Lake Memphramagog	2277	17 43 15.5	" 10 14.80	17 33 0.70	4 34.62		
Rouse's Point ..	2557	17 32 10.2	" 3 44.12	17 28 26.08			
Lake Memphramagog	2277	17 46 7.0	" 10 14.80	17 35 52.20	4 34.32		
Rouse's Point ..	2557	17 35 2.0	" 3 44.12	17 31 17.88			
Lake Memphramagog	2277	17 49 9.0	" 10 14.80	17 38 54.20	4 34.22		
Rouse's Point ..	2557	17 38 4.1	" 3 44.12	17 34 19.98			
Lake Memphramagog	2277	17 52 9.0	" 10 14.80	17 41 54.20	4 34.32		
Rouse's Point ..	2557	17 41 4.0	" 3 44.12	17 37 16.88			
Lake Memphramagog	2277	17 55 9.5	" 10 14.80	17 44 54.7	4 34.62		
Rouse's Point ..	2557	17 44 4.2	" 3 44.12	17 40 20.08			
Lake Memphramagog	2277	17 58 8.0	" 10 14.80	17 47 53.20	4 34.32		
Rouse's Point ..	2557	17 47 3.0	" 3 44.12	17 43 18.88			

Carried forward ... 31.04

Name of Station.	Chrono- meters' Nos.	Flashes observed.	Errors of Chrono- meters on Sidl. Time of Stations.	True Sidl. Time of Observation.	Difference of Longitude.
		H. M. S.	M. S.	Brought forward	31-04
Lake Memphramagog	2277	18 1 7.0	Fast 10 14.80	17 50 52.20	
Rouse's Point ..	2557	17 50 2.0	" 3 44.12	17 46 17.88	4 34.32
Lake Memphramagog	2277	18 4 6.0	" 10 14.80	17 53 51.20	
Rouse's Point ..	2557	17 53 0.7	" 3 44.12	17 49 16.58	4 34.62
Lake Memphramagog	2277	18 7 10.0	" 10 14.80	17 56 55.20	
Rouse's Point ..	2557	17 56 4.7	" 3 44.12	17 52 20.58	4 34.62
Lake Memphramagog	2277	18 10 11.5	" 10 14.80	17 59 56.70	
Rouse's Point ..	2557	17 59 0.0	" 3 44.12	17 55 21.88	4 34.82
Lake Memphramagog	2277	18 13 11.5	" 10 14.80	18 2 56.70	
Rouse's Point ..	2557	18 2 6.4	" 3 44.12	17 58 22.28	4 34.42
Lake Memphramagog	2277	18 16 13.5	" 10 14.80	18 5 58.70	
Rouse's Point ..	2557	18 5 8.4	" 3 44.12	18 1 24.28	4 34.42
Lake Memphramagog	2277	18 19 17.0	" 10 14.8	18 9 2.20	
Rouse's Point ..	2557	18 8 11.7	" 3 44.12	18 4 27.58	4 34.62
Lake Memphramagog	2277	18 22 19.5	" 10 14.8	18 12 4.70	
Rouse's Point ..	2557	18 11 14.2	" 3 44.12	18 7 30.08	4 34.62

15) 67.50

Mean difference of longitude obtained on August 3 = 4 34.50

Signals made on August 5, from 8½ h. to 9½ h.

Lake Memphramagog	2277	17 59 58.0	Fast 10 11.99	17 49 46.01	4 35.05
Rouse's Point ..	2557	17 48 56.5	" 3 45.54	17 45 10.96	
Lake Memphramagog	2277	18 2 55.0	" 10 11.99	17 52 43.01	4 34.05
Rouse's Point ..	2557	17 51 54.5	" 3 45.54	17 48 8.96	
Lake Memphramagog	2277	18 5 52.0	" 10 11.99	17 55 40.01	4 34.15
Rouse's Point ..	2557	17 54 51.4	" 3 45.54	17 51 5.86	
Lake Memphramagog	2277	18 8 54.0	" 10 11.99	17 58 42.01	4 34.65
Rouse's Point ..	2557	17 57 52.9	" 3 45.54	17 54 7.36	
Lake Memphramagog	2277	18 11 53.5	" 10 11.99	18 1 41.51	4 35.05
Rouse's Point ..	2557	18 0 52.0	" 3 45.54	17 57 6.46	
Lake Memphramagog	2277	18 14 55.0	" 10 11.99	18 4 43.01	4 35.05
Rouse's Point ..	2557	18 3 53.5	" 3 45.54	18 0 7.96	
Lake Memphramagog	2277	18 17 56.5	" 10 11.99	18 7 44.51	4 34.35
Rouse's Point ..	2557	18 6 55.7	" 3 45.54	18 3 10.16	
Lake Memphramagog	2277	18 21 0.5	" 10 11.99	18 10 48.51	4 34.55
Rouse's Point ..	2557	18 9 59.5	" 3 45.54	18 6 13.26	
Lake Memphramagog	2277	18 23 58.5	" 10 11.99	18 13 46.51	4 34.55
Rouse's Point ..	2557	18 12 57.5	" 3 45.54	18 9 11.56	
Lake Memphramagog	2277	18 27 1.5	" 10 11.99	18 16 49.51	4 34.45
Rouse's Point ..	2557	18 16 0.6	" 3 45.54	18 12 15.06	
Lake Memphramagog	2277	18 30 8.0	" 10 11.99	18 19 56.01	4 34.55
Rouse's Point ..	2557	18 19 7.0	" 3 45.54	18 15 21.46	

11) 50.45

Mean difference of longitude obtained on August 5 = 4 34.59

Signals made August 24, 1845, from 8h. to 9h., at about 2 minutes intervals.

Name of Station.	Chronometers' Nos.	Flashes observed.	Errors of Chrons. on Sidl. Time of Stations.	True Sidl. Time of Observation.	Difference of Longitude.
		H. M. S.	M. S.	H. M. S.	M. S.
Lake Memphramagog	2277	18 25 12.0	Fast 10 21-12	18 14 50.88	4 34.81
Rouse's Point ..	2557	18 14 16.0	" 3 59-93	18 10 16.07	
Lake Memphramagog	2277	18 36 10.0	" 10 21-12	18 25 48.88	4 35.01
Rouse's Point ..	2557	18 25 13.8	" 3 59-93	18 21 13.87	
Lake Memphramagog	2277	18 40 32.5	" 10 21-12	18 30 11.88	4 35.31
Rouse's Point ..	2557	18 29 36.0	" 3 59-93	18 25 36.07	
Lake Memphramagog	2277	18 47 2.5	" 10 21-12	18 36 41.38	4 35.21
Rouse's Point ..	2557	18 36 6.1	" 3 59-93	18 32 6.17	
Lake Memphramagog	2277	18 49 13.0	" 10 21-12	18 38 51.88	4 34.81
Rouse's Point ..	2557	18 38 17.0	" 3 59-93	18 34 17.07	
Lake Memphramagog	2277	18 51 23.5	" 10 21-12	18 41 2.38	4 34.61
Rouse's Point ..	2557	18 40 27.7	" 3 59-93	18 36 27.77	
Lake Memphramagog	2277	18 53 34.0	" 10 21-12	18 43 12.88	4 35.31
Rouse's Point ..	2557	18 42 37.5	" 3 59-93	18 38 37.57	
Lake Memphramagog	2277	18 55 44.5	" 10 21-12	18 45 23.38	4 34.71
Rouse's Point ..	2557	18 44 48.6	" 3 59-93	18 40 48.67	
Lake Memphramagog	2277	18 57 55.0	" 10 21-12	18 47 33.88	4 34.61
Rouse's Point ..	2557	18 46 59.2	" 3 59-93	18 42 59.27	
Lake Memphramagog	2277	19 0 5.5	" 10 21-12	18 49 44.38	4 34.81
Rouse's Point ..	2557	18 49 9.5	" 3 59-93	18 45 9.57	
Lake Memphramagog	2277	19 2 15.0	" 10 21-12	18 51 53.88	4 34.71
Rouse's Point ..	2557	18 51 19.1	" 3 59-93	18 47 19.17	
Lake Memphramagog	2277	19 4 27.0	" 10 21-12	18 54 5.88	4 35.31
Rouse's Point ..	2557	18 53 30.5	" 3 59-93	18 49 30.57	
Lake Memphramagog	2277	19 6 38.5	" 10 21-12	18 56 17.38	4 34.71
Rouse's Point ..	2557	18 55 42.6	" 3 59-93	18 51 42.67	
Lake Memphramagog	2277	19 8 48.0	" 10 21-12	18 58 26.88	4 35.31
Rouse's Point ..	2557	18 57 51.5	" 3 59-93	18 53 51.57	

14) 69.24

Mean difference of longitude obtained on August 24 = 4 34.95

Signals made on August 26, 1845, from 8 h. to 9 h.

Lake Memphramagog	2277	18 38 44.0	Fast 10 20-91	18 28 23.09	4 35.33
Rouse's Point ..	2557	18 27 49.8	" 4 2-04	18 23 47.76	
Lake Memphramagog	2277	18 40 52.8	" 10 20-91	18 30 31.89	4 35.13
Rouse's Point ..	2557	18 29 58.8	" 4 2-04	18 25 56.76	
Lake Memphramagog	2277	18 43 4.0	" 10 20-91	18 32 43.09	4 35.47
Rouse's Point ..	2557	18 32 11.4	" 4 2-04	18 28 7.62	
Lake Memphramagog	2277	18 47 26.2	" 10 20-91	18 37 5.29	4 35.33
Rouse's Point ..	2557	18 36 32.0	" 4 2-04	18 32 29.96	
Lake Memphramagog	2277	18 49 38.7	" 10 20-91	18 39 17.79	4 35.53
Rouse's Point ..	2557	18 38 44.3	" 4 2-04	18 34 42.26	
Lake Memphramagog	2277	18 51 49.2	" 10 20-91	18 41 28.29	4 35.33
Rouse's Point ..	2557	18 40 55.0	" 4 2-04	18 36 52.96	

Carried forward .. 32.12

Name of Station.	Chronometers' Nos.	Flashes observed.	Errors of Chrons. on Sidl. Time of Stations.	True Sidl. Time of Observation.	Difference of Longitude.
		H. M. S.	M. S.	Brought forward	32.12
Lake Memphramagog	2277	18 53 58.5	Fast 10 20.91	18 43 37.59	
Rouse's Point ..	2557	18 48 4.4	" 4 2.04	18 39 2.36	4 35.23
Lake Memphramagog	2277	18 56 7.6	" 10 20.91	18 45 46.69	
Rouse's Point ..	2557	18 45 13.3	" 4 2.04	18 41 11.26	4 35.43
Lake Memphramagog	2277	19 0 28.8	" 10 20.91	18 50 7.89	
Rouse's Point ..	2557	18 49 34.5	" 4 2.04	18 45 32.46	4 35.43
Lake Memphramagog	2277	19 2 38.6	" 10 20.91	18 52 17.69	
Rouse's Point ..	2557	18 51 44.3	" 4 2.04	18 47 42.26	4 35.43
Lake Memphramagog	2277	19 4 49.7	" 10 20.91	18 54 28.79	
Rouse's Point ..	2557	18 53 55.4	" 4 2.04	18 49 53.36	4 35.43
Lake Memphramagog	2277	19 6 59.2	" 10 20.91	18 56 38.29	
Rouse's Point ..	2557	18 56 4.9	" 4 2.04	18 52 2.86	4 35.43
Lake Memphramagog	2277	19 9 9.0	" 10 20.91	18 58 48.09	
Rouse's Point ..	2557	18 58 14.6	" 4 2.04	18 54 12.56	4 35.53
Lake Memphramagog	2277	19 11 19.2	" 10 20.91	19 0 58.29	
Rouse's Point ..	2557	19 0 24.8	" 4 2.04	18 56 22.76	4 35.53
Lake Memphramagog	2277	19 13 28.7	" 10 20.91	19 3 7.79	
Rouse's Point ..	2557	19 2 34.3	" 4 2.04	18 58 32.26	4 35.53

15) 81.09

Mean difference of longitude obtained on August 26 = 4 35.41

Signals made on August 28, 1845, from 8 h. to 9 h.

Lake Memphramagog	2277	18 45 6.2	Fast 10 21.09	18 34 45.11	4 35.62
Rouse's Point ..	2557	18 34 13.0	" 4 3.51	18 30 9.49	
Lake Memphramagog	2277	18 47 16.4	" 10 21.09	18 36 55.31	4 35.42
Rouse's Point ..	2557	18 36 23.4	" 4 3.51	18 32 19.89	
Lake Memphramagog	2277	18 49 26.8	" 10 21.09	18 39 5.71	4 35.72
Rouse's Point ..	2557	18 38 33.5	" 4 3.51	19 34 29.99	
Lake Memphramagog	2277	18 51 39.2	" 10 21.09	18 41 8.11	4 35.62
Rouse's Point ..	2557	18 40 46.0	" 4 3.51	18 36 42.49	
Lake Memphramagog	2277	18 56 1.6	" 10 21.09	18 45 40.51	4 35.42
Rouse's Point ..	2557	18 45 8.6	" 4 3.51	18 41 5.09	
Lake Memphramagog	2277	18 58 13.0	" 10 21.09	18 47 51.91	4 35.72
Rouse's Point ..	2557	18 47 19.7	" 4 3.51	18 43 16.19	
Lake Memphramagog	2277	19 0 24.8	" 10 21.09	18 50 3.71	4 35.22
Rouse's Point ..	2557	18 49 32.0	" 4 3.51	18 45 28.49	
Lake Memphramagog	2277	19 7 0.0	" 10 21.09	18 56 38.91	4 35.42
Rouse's Point ..	2557	18 56 7.0	" 4 3.51	18 52 3.49	
Lake Memphramagog	2277	19 9 12.7	" 10 21.09	18 58 51.61	4 35.62
Rouse's Point ..	2557	18 58 19.5	" 4 3.51	18 54 15.99	
Lake Memphramagog	2277	19 11 24.2	" 10 21.09	19 1 3.11	4 35.32
Rouse's Point ..	2557	19 0 31.3	" 4 3.51	18 56 27.79	
Lake Memphramagog	2277	19 13 36.0	" 10 21.09	19 3 14.91	4 35.62
Rouse's Point ..	2557	19 2 42.8	" 4 3.51	18 58 39.29	
Lake Memphramagog	2277	19 15 48.6	" 10 21.09	19 5 27.51	4 35.52
Rouse's Point ..	2557	19 4 55.5	" 4 3.51	19 0 51.99	

Carried forward .. 66.24

Name of Station.	Chronometers' Nos.	Flashes observed.	Errors of Chrons. on Sidl. Time of Stations.	True Sidl. Time of Observation.	Difference of Longitude.
		H. M. S.	M. S.	Brought forward	66°24
Lake Memphramagog	2277	19 18 0.5	Fast 10 21.09	H. M. S. 19 7 39.41	M. S. 4 35.52
Rouse's Point ..	2557	19 7 7.4	" 4 3.51	19 3 3.89	
Lake Memphramagog	2277	19 20 12.4	" 10 21.09	19 9 51.31	4 35.52
Rouse's Point ..	2557	19 9 19.5	" 4 3.51	19 3 15.99	
Lake Memphramagog	2277	19 21 23.2	" 10 21.09	19 12 2.11	4 35.52
Rouse's Point ..	2557	19 11 30.3	" 4 3.51	19 7 26.79	
Lake Memphramagog	2277	19 24 35.0	" 10 21.09	19 14 13.91	4 35.42
Rouse's Point ..	2557	19 13 42.0	" 4 3.51	19 9 38.49	
16)					87.82

Mean difference of longitude obtained on August 28 = 4 35.49

ABSTRACT OF FOREGOING.

August	1, difference of longitude by means of	9 flashes	m.	s.
" 3,	"	"	15	"
" 5,	"	"	11	"
" 24,	"	"	14	"
" 26,	"	"	15	"
" 28,	"	"	16	"
6)				30.49

Difference of longitude by a mean of 6 nights' observations = 4 35.08

(Signed)

WM. ROBINSON,

Captain, Royal Engineers.

TIMES of Observations of the Signals made at Jay Mountain for determining the Difference of Longitude between Captain Robinson's Astronomical Station at Lake Memphramagog and that of Lieutenant Thom, United States' Topographical Engineers, at Richford.

Signals made on August 24, 1845, by flashes of gunpowder fired at about 2 minutes intervals, from 8 h. to 9 h., approximate solar time.

Name of Station.	Chronometers' Nos.	Flashes observed.	Errors of Chrons. on Sidl. Time of Station.	True Sidl. Time of Observation.	Difference of Longitude.
		H. M. S.	M. S.	H. M. S.	M. S.
Lake Memphramagog	2277	18 25 12.0	Fast 10 21.12	18 14 50.88	
Richford*	2419	18 12 57.2	.. ..	18 12 57.27	1 53.61
	1582	.34			
Lake Memphramagog	2277	18 27 25.0	.. 10 21.12	18 17 3.88	
Richford	2419	.. ..	.. ..	18 15 10.20	1 53.68
	1582	18 15 10.02			
Lake Memphramagog	2277	18 34 0.8	.. 10 21.12	18 23 38.88	
Richford	2419	18 21 45.10	.. ..	18 21 44.90	1 53.98
	1582	44.69			
Lake Memphramagog	2277	18 36 10.0	.. 10 21.12	18 25 48.88	
Richford	2419	18 23 55.20	.. ..	18 23 55.29	1 53.69
	1582	.39			
Lake Memphramagog	2277	18 38 20.5	.. 10 21.12	18 27 59.38	
Richford	2419	18 26 6.30	.. ..	18 26 6.44	1 52.94
	1582	.59			
Lake Memphramagog	2277	18 40 32.5	.. 10 21.12	18 30 11.38	
Richford	2419	18 28 17.40	.. ..	18 28 17.62	1 53.76
	1582	.85			
Lake Memphramagog	2277	18 42 42.0	.. 10 21.12	18 32 20.83	
Richford	2419	18 30 27.20	.. ..	18 30 27.25	1 53.63
	1582	.30			
Lake Memphramagog	2277	18 44 52.5	.. 10 21.12	18 34 31.38	
Richford	2419	18 32 37.80	.. ..	18 32 37.70	1 53.68
	1582	.60			
Lake Memphramagog	2277	18 47 2.5	.. 10 21.12	18 36 41.38	
Richford	2419	18 34 47.65	.. ..	18 34 47.75	1 53.63
	1582	.91			
Lake Memphramagog	2277	18 49 13.0	.. 10 21.12	18 38 51.88	
Richford	2419	18 36 58.50	.. ..	18 36 58.43	1 53.45
	1582	.37			
Lake Memphramagog	2277	18 51 23.5	.. 10 21.12	18 41 2.88	
Richford	2419	18 39 9.10	.. ..	18 39 9.06	1 53.32
	1582	.03			
Lake Memphramagog	2277	18 53 34.0	.. 10 21.12	18 43 12.88	
Richford	2419	18 41 19.40	.. ..	18 41 19.29	1 53.59
	1582	.19			
Lake Memphramagog	2277	18 55 44.5	.. 10 21.12	18 45 23.38	
Richford	2419	18 43 30.20	.. ..	18 43 30.17	1 53.21
	1582	.14			
Carried forward ..					46.07

* At Richford, the flashes were observed on two chronometers. The mean of the two is used.—W. R.

Name of station.	Chronometers' Nos.	Flashes observed.	Errors of Chrons. on Sidl. Time of Station.	True Sidl. Time of Observation.	Difference of Longitude.
		H. M. S.	M. S.	Brought forward	46-07
Lake Memphramagog	2277	18 57 55-0	Fast 10 21-12	H. M. S.	M. S.
Richford	2419	18 45 40-90	.. ..	18 47 33-88	1 53-03
	1582	80		18 45 40-85	
Lake Memphramagog	2277	19 0 5-5	" 10 21-12	18 49 44-38	1 53-41
Richford	2419	18 47 50-90	.. ..	18 47 50-97	
	1582	51-05			
Lake Memphramagog	2277	19 2 15-0	" 10 21-12	18 51 53-88	1 52-78
Richford	2419	18 50 1-00	.. ..	18 50 1-10	
	1582	21			
Lake Memphramagog	2277	19 4 27-0	" 10 21-12	18 54 5-88	1 54-00
Richford	2419	18 52 11-80	.. ..	18 52 11-88	
	1582	90			
Lake Memphramagog	2277	19 6 38-5	" 10 21-12	18 56 17-38	1 53-47
Richford	2419	18 54 23-90	.. ..	18 54 23-91	
	1582	92			
Lake Memphramagog	2277	19 8 48-0	" 10 21-12	18 58 26-88	1 53-69
Richford	2419	18 56 33-10	.. ..	18 56 33-19	
	1582	29			
					19) 66-45

Mean difference of Longitude on August 24, by 19 observations = 1 53-50

Signals made on August 26, 1845, from 8h. to 9h. P.M. approximate solar time.

Lake Memphramagog	2277	18 38 44-0	Fast 10 20-91	18 28 23-09	1 53-90
Richford	2419	18 26 29-27	.. ..	18 26 29-19	
	1582	12			
Lake Memphramagog	2277	18 40 52-8	" 10 20-91	18 30 31-89	1 53-62
Richford	2419	18 28 38-47	.. ..	18 28 38-37	
	1582	27			
Lake Memphramagog	2277	18 43 4-0	" 10 20-91	18 32 43-09	1 53-60
Richford	2419	18 30 49-27	.. ..	18 30 49-49	
	1582	71			
Lake Memphramagog	2277	18 45 14-8	" 10 20-91	18 34 53-89	1 53-66
Richford	2419	18 33 0-20	.. ..	18 33 0-24	
	1582	29			
Lake Memphramagog	2277	18 47 26-2	" 10 20-91	18 37 5-29	1 53-93
Richford	2419	18 35 11-67	.. ..	18 35 11-36	
	1582	05			
Lake Memphramagog	2277	18 49 38-7	" 10 20-91	18 39 17-79	1 54-05
Richford	2419	18 37 23-77	.. ..	18 37 23-74	
	1582	71			
Lake Memphramagog	2277	18 51 49-2	" 10 20-91	18 41 28-29	1 53-78
Richford	2419	18 39 34-67	.. ..	18 39 34-51	
	1582	36			
Lake Memphramagog	2277	18 53 58-5	" 10 20-91	18 43 37-59	1 54-00
Richford	2419	18 41 43-77	.. ..	18 41 43-59	
	1582	42			
Lake Memphramagog	2277	18 58 18-5	" 10 20-91	18 47 57-59	1 53-79
Richford	2419	18 46 3-67	.. ..	18 46 3-80	
	1582	93			
Lake Memphramagog	2277	19 0 28-8	" 10 20-91	18 50 7-89	1 54-62
Richford	2419	19 48 13-17	.. ..	18 48 13-27	
	1582	38			

Carried forward .. 38-84

Name of Station.	Chronometers' Nos.	Flashes observed.	Errors of Chrono. on Sidl. Time of Station.	True Sidl. Time of Observation.	Difference of Longitude.
		H. M. S.	M. S.	Brought forward	M. S.
Lake Memphramagog	2277	19 2 38.6	Fast 10 20.91	18 52 17.69	38.84
Richford	2419	18 50 24.07	.. ..	18 50 24.00	1 53.69
	1582	23.94	..		
Lake Memphramagog	2277	19 4 49.7	" 10 20.91	18 54 28.79	
Richford	2419	18 52 34.87	.. ..	18 52 35.03	1 53.66
	1582	35.19	..		
Lake Memphramagog	2277	19 6 59.2	" 10 20.91	18 56 38.29	
Richford	2419	18 54 44.57	.. ..	18 54 44.57	1 53.72
	1582				
Lake Memphramagog	2277	19 9 9.0	" 10 20.91	18 58 48.09	
Richford	2419	18 56 44.47	.. ..	18 56 54.47	1 53.62
	1582				
Lake Memphramagog	2277	19 11 19.2	" 10 20.91	19 0 58.29	
Richford	2419	18 59 4.57	.. ..	18 59 4.46	1 53.83
	1582	.36			
Lake Memphramagog	2277	19 13 28.7	" 10 20.91	19 3 7.79	
Richford	2419	19 1 13.87	.. ..	19 1 13.84	1 53.95
	1582	.81			
					16) 61.31

Mean difference of longitude on August 26, by 16 observations = 1 53.83

Signals made on August 28, 1845, from 8h. to 9h., approximate solar time.

Lake Memphramagog	2277	18 45 6.2	Fast 10 21.09	18 34 45.11	
Richford	2419	18 32 51.36	.. ..	18 32 51.51	1 53.60
	1582	.67			
Lake Memphramagog	2277	18 47 16.4	" 10 21.09	18 36 55.31	
Richford	2419	18 35 1.46	.. ..	18 35 1.74	1 53.57
	1582	2.03			
Lake Memphramagog	2277	18 49 26.8	" 10 21.09	18 39 5.71	
Richford	2419	18 37 11.76	.. ..	18 37 12.03	1 53.68
	1582	12.29			
Lake Memphramagog	2277	18 51 39.2	" 10 21.09	18 41 18.11	
Richford	2419	18 39 24.36	.. ..	18 39 24.61	1 53.50
	1582	.86			
Lake Memphramagog	2277	18 56 1.6	" 10 21.09	18 45 40.51	
Richford	2419	18 43 46.86	.. ..	18 43 47.01	1 53.50
	1582	47.16			
Lake Memphramagog	2277	18 58 13.0	" 10 21.09	18 47 51.91	
Richford	2419	18 45 57.86	.. ..	18 45 58.24	1 53.67
	1582	58.62			
Lake Memphramagog	2277	19 0 24.8	" 10 21.09	18 50 3.71	
Richford	2419	18 48 9.76	.. ..	18 48 9.97	1 53.74
	1582	10.18			
Lake Memphramagog	2277	19 7 0.0	" 10 21.09	18 56 38.91	
Richford	2419	18 54 43.26	.. ..	18 54 45.26	1 53.65
	1582				
Lake Memphramagog	2277	19 9 12.7	" 10 21.09	18 58 51.61	
Richford	2419	18 56 57.66	.. ..	18 56 58.04	1 53.57
	1582	58.42			
Lake Memphramagog	2277	19 11 24.2	" 10 21.09	19 1 3.11	
Richford	2419	18 59 9.56	.. ..	18 59 9.77	1 53.34
	1582	.98			

Carried forward .. 35.82

Name of Station.	Chronometers Nos.	Flashes observed.	Errors of Chrons. on Sidl. Time of Station.	True Sidl. Time of Observation.	Difference of Longitude.
		H. M. S.	M. S.	Brought forward H. M. S.	M. S.
Lake Memphramagog	2277	19 13 36.0	Fast 10 21.09	19 3 14.91	35.82
Richford	2419	19 1 21.15	.. ..	19 1 21.34	1 53.57
	1582	.54			
Lake Memphramagog	2277	19 15 48.6	" 10 21.09	19 5 27.51	1 53.65
Richford	2419	19 3 33.86	.. ..	19 3 33.86	
	1582				
Lake Memphramagog	2277	19 18 0.5	" 10 21.09	19 7 39.41	1 53.60
Richford	2419	19 5 45.76	.. ..	19 5 45.81	
	1582	.86			
Lake Memphramagog	2277	19 22 23.2	" 10 21.09	19 12 2.11	1 53.85
Richford	2419	19 10 8.26	.. ..	19 10 8.26	
	1582				
Lake Memphramagog	2277	19 24 35.0	" 10 21.09	19 14 13.91	1 53.31
Richford	2419	19 12 20.26	.. ..	19 12 20.60	
	1582	.94			
					15) 53.80

Mean difference of longitude on August 28, by 15 observations = 1 53.58

Signals made on August 29, 1845 between 8 h. and 9 h., approximate solar time.

Lake Memphramagog	2277	19 9 56.8	Fast 10 21.10	18 59 35.70	1 54.06
Richford	2419	18 57 41.70	.. ..	18 57 41.64	
	1582	.59			
Lake Memphramagog	2277	19 14 20.2	" 10 21.10	19 3 59.1	1 54.20
Richford	2419	19 2 4.70	.. ..	19 2 4.90	
	1582	5.11			
Lake Memphramagog	2277	19 16 31.30	" 10 21.10	19 6 10.20	1 53.92
Richford	2419	19 4 16.20	.. ..	19 4 16.28	
	1582	.37			
Lake Memphramagog	2277	19 20 54.4	" 10 21.10	19 10 33.3	1 54.16
Richford	2419	19 8 39.10	.. ..	19 8 33.14	
	1582	.19			
Lake Memphramagog	2277	19 23 5.8	" 10 21.10	19 12 44.7	1 54.18
Richford	2419	19 10 50.60	.. ..	19 10 50.52	
	1582	.45			
Lake Memphramagog	2277	19 25 17.6	" 10 21.10	19 14 56.5	1 53.80
Richford	2419	19 13 2.40	.. ..	19 13 2.70	
	1582	3.01			
Lake Memphramagog	2277	19 27 29.5	" 10 21.10	19 17 8.4	1 54.27
Richford	2419	19 15 14.10	.. ..	19 15 14.13	
	1582	.17			
Lake Memphramagog	2277	19 29 40.4	" 10 21.1	19 19 19.3	1 54.33
Richford	2419	19 17 24.90	.. ..	19 17 24.97	
	1582	25.03			
					8) 32.92

Mean difference of longitude on August 29, by 8 observations = 1 54.11

Signals made on September 8, 1845, from 8h. to 9h., approximate solar time.

Name of Station.	Chronometers' Nos.	Flashes observed.	Errors of Chronm. on Sidl. Time of Station.	True Sidl. Time of Observation.	Difference of Longitude.
		H. M. S.	M. S.	H. M. S.	M. S.
Lake Memphramagog	2277	19 29 33.6	Fast 10 14.84	19 19 18.76	
Richford	2419	19 17 24.86	.. ..	19 17 24.84	1 53.92
	1582	.83			
Lake Memphramagog	2277	19 31 45.8	" 10 14.84	19 21 30.96	
Richford	2419	19 19 37.15	.. ..	19 19 37.17	1 53.79
	1582	.19			
Lake Memphramagog	2277	19 33 56.8	" 10 14.84	19 23 41.96	
Richford	2419	19 21 48.15	.. ..	19 21 48.15	1 53.81
	1582	.15			
Lake Memphramagog	2277	19 36 10.5	" 10 14.84	19 25 55.66	
Richford	2419	19 24 0.95	.. ..	19 24 0.88	1 54.78
	1582	.81			
Lake Memphramagog	2277	19 38 22.0	" 10 14.84	19 28 7.16	
Richford	2419	19 26 13.15	.. ..	19 26 13.21	1 53.95
	1582	.27			
Lake Memphramagog	2277	19 40 33.5	" 10 14.84	19 30 18.66	
Richford	2419	19 28 24.75	.. ..	18 28 24.73	1 53.93
	1582	.71			
Lake Memphramagog	2277	19 42 45.2	" 10 14.84	19 32 30.36	
Richford	2419	19 30 36.55	.. ..	19 30 36.62	1 53.74
	1582	.69			
Lake Memphramagog	2277	19 44 56.4	" 10 14.84	19 34 41.16	
Richford	2419	19 32 47.55	.. ..	19 32 47.45	1 54.11
	1582	.35			
Lake Memphramagog	2277	19 47 9.0	" 10 14.84	19 36 54.16	
Richford	2419	19 35 0.55	.. ..	19 35 0.43	1 53.73
	1582	.31			
Lake Memphramagog	2277	19 49 20.2	" 10 14.84	19 39 5.36	
Richford	2419	19 37 11.25	.. ..	19 37 11.45	1 53.91
	1582	.66			
Lake Memphramagog	2277	19 51 32.5	" 10 14.84	19 41 17.66	
Richford	2419	19 39 23.85	.. ..	19 39 23.84	1 53.82
	1582	.83			
Lake Memphramagog	2277	19 53 44.2	" 10 14.84	19 43 29.36	
Richford	2419	19 41 35.25	.. ..	19 41 35.27	1 54.09
	1582	.29			
Lake Memphramagog	2277	19 55 56.7	" 10 14.84	19 45 41.86	
Richford	2419	19 43 47.95	.. ..	19 43 47.85	1 54.01
	1582	.75			
Lake Memphramagog	2277	19 58 8.5	" 10 14.84	19 47 53.66	
Richford	2419	19 45 59.75	.. ..	19 45 58.48	1 54.18
	1582	.21			
Lake Memphramagog	2277	20 0 20.8	" 10 14.84	19 50 5.96	
Richford	2419	19 48 11.75	.. ..	19 48 11.66	1 54.30
	1582	.57			
Lake Memphramagog	2277	20 2 31.0	" 10 14.84	19 52 16.16	
Richford	2419	19 50 22.35	.. ..	19 50 22.54	1 53.62
	1582	.73			
Lake Memphramagog	2277	20 4 44.2	" 10 14.84	19 54 29.36	
Richford	2419	19 52 35.05	.. ..	19 52 35.17	1 54.19
	1582	.29			

Carried forward .. 67.88

Name of Station.	Chronometers' Nos.	Flashes observed.	Errors of Chrons. on Sidl. Time of Station.	True Sidl. Time of Observation.	Difference of Longitude.
		H. M. S.	M. S.	Brought forward	67-88
Lake Memphramagog	2277	20 6 56-0	Fast 10 14-84	19 56 41-16	
Richford	2419	19 54 47-05	.. ..	19 54 47-00	1 54-16
	1582	46-95			
Lake Memphramagog	2277	20 9 8-8	" 10 14-84	19 58 53-96	
Richford	2419	19 57 0-02	.. ..	19 57 0-02	1 53-94
	1582				
Lake Memphramagog	2277	20 11 20-8	" 10 14-84	20 1 5-96	
Richford	2419	19 59 11-75	.. ..	19 59 11-75	1 54-21
	1582				
Lake Memphramagog	2277	20 20 8-8	" 10 14-84	20 9 53-96	
Richford	2419	20 8 0-05	.. ..	20 7 59-97	1 53-99
	1582	7 59-89			
Lake Memphramagog	2277	20 22 1-0	" 10 14-84	20 12 6-16	
Richford	2419	20 10 12-35	.. ..	20 10 12-32	1 53-84
	1582	29			
					22) 88-02

Mean difference of longitude on September 8, by 22 observations = 1 54-00

Signals made on September 16, 1845, from 8 h. to 9 h., approximate solar time.

Lake Memphramagog	2277	20 0 29-7	Fast 9 45-66	19 50 44-04	
Richford	2419	19 48 50-75	.. ..	19 48 50-57	1 53-47
	1582	40			
Lake Memphramagog	2277	20 4 45-4	" 9 45-66	19 54 59-74	
Richford	2419	19 53 6-36	.. ..	19 53 6-44	1 53-30
	1582	52			
Lake Memphramagog	2277	20 6 53-3	" 9 45-66	19 57 7-64	
Richford	2419	19 55 14-45	.. ..	19 55 14-55	1 53-09
	1582	65			
Lake Memphramagog	2277	20 9 1-5	" 9 45-66	19 59 15-84	
Richford	2419	19 57 22-35	.. ..	19 57 22-32	1 53-52
	1582	30			
Lake Memphramagog	2277	20 11 9-4	" 9 45-66	20 1 23-74	
Richford	2419	19 59 30-25	.. ..	19 59 30-29	1 53-45
	1582	34			
Lake Memphramagog	2277	20 13 17-0	" 9 45-66	20 3 31-34	
Richford	2419	20 1 38-25	.. ..	20 1 38-22	1 53-12
	1582	20			
Lake Memphramagog	2277	20 15 24-8	" 9 45-66	20 5 39-14	
Richford	2419	20 3 45-95	.. ..	20 3 46-00	1 53-14
	1582	46-04			
Lake Memphramagog	2277	20 17 32-8	" 9 45-66	20 7 47-14	
Richford	2419	20 5 53-85	.. ..	20 5 53-92	1 53-22
	1582	54-00			
Lake Memphramagog	2277	20 19 14-2	" 9 45-66	20 9 55-54	
Richford	2419	20 8 2-05	.. ..	20 8 2-19	1 53-35
	1582	34			
Lake Memphramagog	2277	20 21 49-5	" 9 45-66	20 12 3-84	
Richford	2419	20 10 10-55	.. ..	20 10 10-52	1 53-32
	1582	49			
Carried forward					.. 32-98

Name of Station.	Chronometers' Nos.	Flashes observed.	Errors of Chrons. on Sidl. Time of Station.	True Sidl. Time of Observation.	Difference of Longitude.
		H. M. S.	M. S.	Brought forward	32-98
Lake Memphramagog	2277	20 26 6.8	Fast 9 45-66	H. M. S. 20 16 21-14	M. S.
Richford	2419	20 14 27-75	.. .. .	20 14 27-93	1 53-21
	1582	28-10			
Lake Memphramagog	2277	20 32 32-3	" 9 45-66	20 22 46-64	
Richford	2419	20 20 53-25	.. .. .	20 20 53-30	1 53-34
	1582	.85			
Lake Memphramagog	2277	20 34 40-8	" 9 45-66	20 24 55-14	
Richford	2419	20 23 1-45	.. .. .	20 23 1-47	1 53-67
	1582	50			
Lake Memphramagog	2277	20 36 49-40	" 9 45-66	20 27 3-74	
Richford	2419	20 25 10-35	.. .. .	20 25 10-35	1 53-39
	1582				
Lake Memphramagog	2277	20 38 57-60	" 9 45-66	20 29 11-94	
Richford	2419	20 27 18-45	.. .. .	20 27 18-47	1 53-47
	1582	.50			
					15) 50-06

Mean difference of longitude on September 16, by 15 observations = 1 53-33

ABSTRACT OF FOREGOING.

				M.	S.
August	24, mean result of 19 corresponding observations	..	1	53-50	
"	26, " 16	"	1	53-83	
"	28, " 15	"	1	53-58	
"	29, " 8	"	1	54-11	
September	8, " 22	"	1	54-00	
"	16, " 15	"	1	53-33	
					6) 22-35

Mean of the above 6 sets, comprising 95 observations = 1 53-72

Richford Station, west of Lake Memphramagog Station .. 1 53-72

(Signed) WM. ROBINSON,
Captain, Royal Engineers.

ABSTRACT of differences of Longitude determined by Captain Robinson and Lieutenant Pipon of the Royal Engineers, employed on the North American Boundary, under the Treaty of Washington; in the years 1843, 1844, and 1845.

	M.	S.
1. Between Grand Falls and Little Falls (or Madawaska) on the River St. John, New Brunswick	2	19-18
2. Grand Falls and due North Line run by Major Graham from the monument at the source of the St. Croix River. By triangulation	0	9-60
3. Grand Falls and the Boundary Line at its junction with the St. John River. By triangulation	0	11-76
4. Little Falls (or Madawaska) and the River St. Francis	2	20-43
5. Mouth of the River St. Francis and the outlet of the Lake Pohenagamook	1	17-47
6. Mouth of the River St. Francis and the mouth of the Great Black River	2	11-34
7. Mouth of the Great Black River and the forks of the River St. John	1	42-14
8. Forks of the River St. John and the North-West Branch Station. By measurement	0	28-47
9. North-West Branch Station and the South-West Branch point in $46^{\circ} 25'$ of latitude	0	14-30
10. North-West Branch Station and Lake Hill. By triangulation	0	69
11. Lake Hill and Quebec, determined by signals	4	46-32
12. Astronomical Station, Quebec, and flag-staff, N.E. bastion of citadel. By triangulation	0	3-38
13. Astronomical Station, Quebec, and Protestant Cathedral, Quebec	0	2-95
14. Astronomical Station, Quebec, and Catholic Cathedral, Quebec	0	2-85
15. Quebec and St. Helen's Island	9	17-73
16. St. Helen's Island and Protestant Cathedral, Montreal. By triangulation	0	5-55
17. St. Helen's Island and Catholic Cathedral, Montreal. By triangulation	0	5-66
18. St. Helen's Island and St. Regis	4	29-15
19. St. Helen's Island and Rouse's Point	0	44-09
20. Rouse's Point and Lake Memphramagog by signals	4	35-08
21. Lake Memphramagog and Richford. By signals	1	53-72

(Signed)

WM. ROBINSON,
Captain, Royal Engineers.

GENERAL ABSTRACT of Latitudes and Longitudes of Stations, determined by Captain Robinson and Lieutenant Pilon, of the Royal Engineers, employed on the North American Boundary, under the Treaty of Washington; in the years 1843, 1844, and 1845.

North Latitude.	NAMES OF STATIONS.	West Longitude.	
		Time.	Arc.
° ' "		H. M. S.	° ' "
47 2 50	Astronomical Station at the Grand Falls, New Brunswick	4 30 47.22	67 41 48.3
47 2 55	Costegan's Inn at the Grand Falls, 505 feet north, and 350 east of Astronomical Station	4 30 46.89	67 41 43.3
47 3 36	Due North Line run by Major Graham from the Monument at the St. Croix River at its junction with the St. John River	4 30 56.82	67 44 12.3
47 3 58	Boundary Line near Grand Falls, at its junction with the River St. John	4 30 58.98	67 44 44.7
47 21 50	Astronomical Station at the Little Falls of the River St. John, and near the mouth of the Madawaska River. The station was 90 feet north and 70 feet east of the Blockhouse at Madawaska River	4 33 6.40	68 16 36.0
47 10 57	Astronomical Station near mouth of River St. Francis. The station was 130 feet south and 52 feet west of Hammond's Barn	4 35 26.83	68 51 42.4
47 27 33	Astronomical Station at outlet of Lake Pohenagmook. The large iron monument marking the Boundary was placed 66 feet north and 68 feet west nearly of station.	4 36 44.30	69 11 4.5
46 56 55	Astronomical Station at mouth of Great Black River	4 37 38.17	69 24 32.5
46 56 57	Centre of Island at ditto, 200 feet north and 550 feet east of Astronomical Station	4 37 37.64	69 24 24.6
46 34 38	Astronomical Station 1 mile north of the forks of the River St. John. The station was about 1 mile north of the actual fork of the river, and 441 feet from the water's edge, at the south-east extremity of the 10 mile (by Treaty) Line	4 39 20.31	69 50 4.6
46 41 45	Astronomical Station at the north-west branch of the River St. John. The station was 166 feet from the north-west extremity of the 10-mile Treaty Line. The large iron monument at this point to mark the end of the 64-mile straight line drawn from the outlet of Lake Pohenagmook, was placed close to where the instrument stood.	4 39 48.78	69 57 11.7
46 42 15	Astronomical Station on the top of Lake Hill	4 39 55.68	69 58 55
46 24 53	Astronomical Station on the south-west branch of the River St. John	4 40 4.94	70 1 14
46 25 0	Large iron monument marking the 46° 25' Point by Treaty, on the south-west branch of River St. John	4 40 3.08	70 0 46
46 48 5	Astronomical Station, Plains of Abraham, Quebec	4 44 42.00	71 10 30
46 48 26	Flag-staff, north-east bastion of the Citadel	4 44 38.62	71 9 39.3
46 48 40	Protestant Cathedral, Quebec	4 44 39.15	71 9 47
46 48 43	Catholic Cathedral, Quebec	4 44 39.05	71 9 45
45 0 28	Astronomical Station, Lake Memphramagog	4 48 40.56	72 10 8
45 0 18	Station 338 feet N.W. of the barn on Blackader's farm		
	Iron monument on the Boundary Line, 1019 feet due south of the Astronomical Station	4 48 40.56	72 10 8
	Richford Station. Station of Lieutenant Thom, United States' Topographical Engineers.	4 50 34.28	72 38 34
45 0 28	Astronomical Station, Rouse's Point. Station of Major Graham, United States' Topographical Engineers	4 53 15.64	73 18 54
45 30 53	Latitude of Fort determined by Major Graham 45° 0' 27"		
	Astronomical Station, St. Helen's Island, Montreal	4 53 59.73	73 29 56
	Station 294 south and 445 feet of the Barony House		
45 30 26	Protestant Cathedral, Montreal	4 54 5.28	73 31 19
45 30 21	Catholic Cathedral, Montreal	4 54 5.39	73 31 21
44 59 59	Boundary Line, 4 miles from Russeltown.		
	Astronomical Station, 1422 feet west of the monument on the road crossing the Line near John McCoy's house.		
44 59 35	Boundary Line, Trout River.		
	Astronomical Station, 122 feet south and 226 feet east of monument on east bank of river		
44 59 58	Astronomical Station, St. Regis	4 58 28.88	74 57 13
45 0 1	Large iron monument at the junction of the Boundary Line with the St. Lawrence River, 280 feet north and 186 feet east of Astronomical Station	4 58 28.71	74 37 10

(Signed) WM. ROBINSON,
Captain, Royal Engineers.

Report of Lieutenant Pipon.

For the purpose of tracing portions of the North-Eastern Boundary, and for making a correct map of the whole Line, it was necessary to determine the difference of longitude between several points along the frontier.

A brief statement of the modes adopted in getting the difference of longitude is here given, together with a report on the chronometers used for that purpose.

The officers of Royal Engineers, and six non-commissioned officers of the Royal Sappers and Miners, appointed to this duty, were ordered to proceed to America with the necessary instruments and chronometers, by the mail steamer "Hibernia," on the 19th April, 1843.

The chronometers used on the expedition were selected by Professor Airy. They consisted of—

Sidereal Box Chronometers.	Heyes, 51	1 day.
Ditto	Arnold, 341	ditto.
Ditto	Parkinson & Frodsham, 2277.	2 day.
Ditto	Frodsham, 2	ditto.
Mean time Pocket Chrons.	Arnold, 2111	1 day.
Ditto	Arnold, 2187	ditto.
Ditto	Molyneux, 3091	ditto.
Ditto	Molyneux, 3147	2 day.
Ditto	Molyneux, 3148	ditto.
Ditto	Molyneux, 3226	1 day.
Ditto	Molyneux, 3227	ditto.

Of these, the four box chronometers belonged to the Admiralty; Nos. 2111, 2187, and 3091, belonged to the Foreign Office, and had been in use on former occasions; Nos. 3147 and 3148 were purchased expressly for the expedition; and 3226 and 3227 were lent for the expedition.

For some time previous to setting out, the chronometers were kept at the Royal Observatory, Greenwich, for the purpose of being rated.

They were removed from the Observatory on the 16th April, and carried down to the railway; and on arrival in London, were conveyed by hackney-coach to the terminus of the Birmingham Railway; from thence they were conveyed on the following morning to Liverpool.

A shelf had been previously fitted up in one of the state-cabins of the "Hibernia" for their reception; and on the morning of the 19th, the day of departure, they were taken on board, and were wound up during the passage out by Captain Robinson. The box chronometers were kept ungymballed whilst on board.

There were two days of very rough weather and heavy sea immediately after leaving Liverpool; the rest of the passage out, with exception of one day off the coast of Newfoundland, was tolerably smooth.

It had been intended that the party should have stopped at Halifax, and gone across by land to the Bay of Fundy, and from thence up the River St. John in New Brunswick, to the scene of operation; but with a view of avoiding the land-carriage for the chronometers, instructions were left at Halifax by Colonel Estcourt, directing the party to go on to Boston, and proceed from thence by another steamer to St. John's.

The steamer arrived in Boston on the 4th of May; the chronometers were landed with great care. On the 5th, Captain Robinson and Lieutenant Pipon compared the box chronometers with the sidereal clock at Cambridge Observatory; and on the following day the pocket chronometers were sent for comparisons to Mr. Bond, in Congress-street. Having thus obtained the errors of all the chronometers on the sidereal and mean time of Old Cambridge Observatory, and the longitude of Old Cambridge Observatory, deduced from a very great number of observations, being 4h. 44m. 29.6s. west of Greenwich, by applying this quantity to the comparisons made, and balancing the results with the errors of the

chronometers on leaving Greenwich, the average rates during the passage out have been ascertained.

On Saturday evening, the 6th May, the chronometers were taken on board the "New Brunswick" steamer, which left this evening for St. John's, and arrived there on the Monday. The party were detained for some time at St. John's and Fredericton, waiting for the waters caused by the melting of the snow to subside. The chronometers were regularly wound up and compared during this time; but there were no means of ascertaining their rates until after the arrival of Captain Robinson and Lieutenant Pipon at their stations at the end of June. The whole passage from St. John's to the Grand Falls was made by water, they did not therefore receive any shock liable to affect them.

Captain Robinson commenced his observations at the Grand Falls, and kept with him—

Box Chronometer Heyes, 51.

Parkinson and Frodsham 2277 (used as standard).

Pocket Chronometers.

Arnold 2187.

Molyneux 3147.

Molyneux 3091.

Lieutenant Pipon proceeded by water to the mouth of Madawaska River, taking with him the other chronometers, viz.—

Box Chronometers.

Arnold 341 (used as standard).

Frodsham 2.

Pocket Chronometers.

Molyneux 3148.

Molyneux 3226.

Molyneux 3227.

Pocket chronometer Arnold 2111 was found to be quite useless; it frequently stopped after being wound up, and could not at all be depended on. No further mention is made of it in this report.

After observing with the transit instruments for time, the pocket chronometers at both stations were transmitted from one to the other three times, after being compared with the standards, for the purpose of getting the difference of longitude between the stations. They were placed in their own boxes, which were packed in one large box with horse-hair, &c., and were conveyed from one station to another, in a flat-bottomed boat, or bateau. The chronometers, when not travelling, were kept in as cool a place as possible, and were all compared with the standard, daily.

From the Grand Falls, Captain Robinson moved up to the mouth of the River St. Francis, and the same number of interchanges were made between St. Francis and Madawaska as had been made between Madawaska and the Grand Falls. After which, Lieutenant Pipon moved up the St. Francis to the outlet of Lake Pohenagamook, from which station interchanges were made with Captain Robinson at the mouth of the St. Francis. The only difference in the mode of conducting these interchanges from that described between the Grand Falls and Madawaska, was, that in this case, bark canoes manned by Indians were used instead of bateaux. The navigation of the river being more difficult, owing to rapids and shallow places, in all cases the chronometers were accompanied by a non-commissioned officer of the Royal Sappers and Miners, whose duty it was to wind them up when detained more than twenty-four hours between the stations. Along the St. Francis it was also necessary to carry them by hand part of the way, across portages which had been cut to avoid some of the worst rapids.

After completing the necessary observations at the outlet of Lake Pohenagamook, Lieutenant Pipon proceeded by canoe down the St. Francis, and up the St. John, to the mouth of the Great Black River, where another astronomical station was established. Similar interchanges of chronometers were carried on between Black River and St. Francis, as before described, after which Captain Robinson removed from St. Francis, and passed up the St. John beyond Black River, to the Forks of the St. John, at which place another astronomical station was established. The season had now become so far advanced that it was found imprac-

licable to carry on the comparisons in the same manner as heretofore. Lieutenant Pípon sent his chronometers by water to Captain Robinson for that purpose, but the weather coming on very severe, the men were obliged to abandon their boats before arriving at the Forks, and the chronometers were carried by hand the remainder of the distance to that station, where they were detained until the month of January, when the river being sufficiently frozen over for sleighs to travel on it, the chronometers were conveyed from one station to the other on the ice. The general result of all these comparisons for difference of longitude was most satisfactory, as was proved by the accurate bearing of the Sixty-Four Mile Trial Line, computed from these differences. But still it was found that some of the chronometers suffered severely from the extreme cold, particularly chronometers 3227 and 3091, which could not be relied upon during the last interchanges between the Forks and the Great Black River.

During the months of November, December, and January, the cold was most intense; on several occasions at Black River and the Forks, the mercury in the thermometers had shrunk within the bulb, and the degree of cold could not be noted. At this time the box chronometers were carefully packed up in a box with woollen and horse-hair, and kept in the wooden houses which had been put up for the officers, which were heated by stoves; and at Black River, when observing for time, they were not moved out, but the time was called and noted by one of the sappers remaining in the house which adjoined the observatory.

Arnold 341, and Frodsham 2, do not appear to have been sensibly affected by the cold, but Parkinson and Frodsham 2277, and Heyes 51, altered their rate considerably.

Up to this time, the chronometers had been moved about with the greatest care, and without any accident or probability of any great shock. It was now, however, necessary to carry Lieutenant Pípon's chronometers out of the woods by a new road to St. Thomas, and to remove them from thence by land-carriage to Rivière du Loup and Lake Pohenagamook, from whence the Trial Line was to be run early in March. They were carried to St. Thomas by hand, and were taken the remainder of the distance by cariole over a very rough road; they do not seem, however, to have suffered materially in consequence. Lieutenant Pípon's chronometers were carried with him along the Line as far as he went, and were afterwards taken out, by hand, to St. Francis Bridge and to Rivière du Loup and St. Thomas, in a spring-waggon. They were also carried by hand from St. Thomas to the North-West Branch Station, at the end of May 1844, to be in time for the commencement of operations at the South-West Branch. There were no means of ascertaining the rates of the chronometers during their journeys.

Captain Robinson's chronometers had remained all this time at the North West-Branch.

In June 1844 the tracing of the Sixty-Four Mile Line having been most satisfactorily completed, the astronomical parties re-assembled at the North-West Branch, when Captain Robinson established his station, and Lieutenant Pípon proceeded by water with his chronometers and instruments down the North-West Branch, and up the South-West Branch, to find the point required by Treaty, where the parallel of latitude $46^{\circ} 25'$ intersects the South-West Branch. Having fixed, after three trials, upon a station near the required point, the pocket chronometers were again used in determining the difference of longitude between Captain Robinson's and Lieutenant Pípon's stations; and all the necessary observations being made and the calculations deduced, the South Line was cut out during the month of August, after which Lieutenant Pípon returned to the North-West Branch, and proceeded from thence to Quebec, to which point the Astronomical Stations hitherto observed from were to be referred. The chronometers were carried by hand to St. Thomas, as before, and in a spring-waggon from thence to Quebec. After which Lieutenant Pípon's chronometers received very little shaking, until the completion of the work. And from this date a more complete detail of their rates can be given.

The length of time necessary to obtain interchanges of chronometers between Quebec and the North-West Branch, and the badness of the road which the chronometers would have to travel over, required that some other means should be adopted in obtaining the difference of longitude, and the system of observing signals simultaneously was resorted to. For this purpose Captain Robinson moved his observatory to the top of a hill about two miles west of the North-West Branch Station (which he connected with it by triangulation), from which hill he could see the dividing range between the St. Lawrence and St. John waters. This range was also visible from the heights of Quebec, on a part of which, near the Plains of Abraham, Lieutenant Pípon's Astronomical station has been established. A party was sent under Serjeant McGuekin, Royal Sappers and Miners, to select a convenient spot on the highest part of this range to fire flashes of gunpowder from; he was provided with a pocket chronometer adjusted to Quebec mean time, and was desired to fire flashes of gunpowder at ten minute intervals, commencing each evening at 8, and continuing until 10 p. m. The quantity of gunpowder used for each flash varied from a quarter to a half a pound.

The hill from which the flashes were fired was nearly due east of Quebec, and about forty miles distant; being thickly wooded, and the party not being able to clear sufficiently to see off the summit in both directions, a high platform was erected, and a contrivance was also adopted for firing the flashes from the top of a high tree, by hoisting the charge, with a slow match attached to it, by means of a pulley fastened to a branch near the top.

The result of the flashing was very successful: on a clear night the flashes were seen distinctly from Quebec Observatory with the naked eye, but were generally observed with the telescope. Simultaneous observations were made on six different evenings, in which forty-six flashes were noted, the difference obtained by which agreed very closely with each other. Captain Robinson and Lieutenant Pípon each afterwards made an attempt to get the difference of longitude between their stations by transmission of their pocket chronometers; but the result so obtained was worthless compared with that deduced from the flashes.

These observations being completed, Captain Robinson left the woods, and having selected a site on St. Helen's Island for an astronomical station to be prepared for him by the following spring, left his chronometers in charge of a non-commissioned officer of Sappers at Montreal, to be wound up and compared during the winter, and went to England. He took home with him one of the box chronometers (Heyes 51), which had been found to be most affected by change of temperature, and in the spring brought sidereal chronometer (Molyneux 943) in the place of it.

Lieutenant Pípon remained at Quebec during the winter, principally for the purpose of observing lunar transits for absolute longitude.

On Captain Robinson's return in the spring, interchanges of chronometers were made between the Quebec and St. Helen's stations; these were obtained with great facility, the chronometers being conveyed between the two places by the steamers which run daily.

From Quebec Lieutenant Pípon moved to the extreme west end of the North-East Boundary where the 45th parallel intersects the St. Lawrence at St. Regis, and made interchanges between St. Helen's and St. Regis. In making these the chronometers were taken across between St. Regis and Cornwall, by canoe, and from thence to Montreal and back, by the regular mail conveyance, which is part steamer and part coach.

Lieutenant Pípon's chronometers were not used for any further interchanges. Captain Robinson obtained the difference of longitude between his station at St. Helen's and Major Graham's station at Rouse's Point, by interchanges of chronometers in a similar manner to those described.

The difference of longitude between St. Regis and St. Helen's having been ascertained, and also that between Rouse's Point and St. Helen's, by the transmission of chronometers, an opportunity was afforded of testing the accuracy of these observations, and of getting a more correct determination of the difference of longitude between the astronomical stations at St. Regis and Rouse's Point, which were about sixty-four miles apart,

and on the 45th parallel. From a hill near the village of St. Regis, and about half a mile from the station, a range of highlands was seen extending to the south and south-east, and apparently from thirty to forty miles distant.

Lieutenant Pipon suggested to Colonel Estcourt the probability of some part of this range being visible from the neighbourhood of Major Graham's station at Rouse's Point; and if so, the desirability of trying to obtain the difference of longitude by simultaneous observations of signals made at such a point.

Major Graham immediately concurred with this proposition, and having ascertained by bearing and approximate distance, the position on the map, of the highest and most suitable hill in the range, a party was sent from each of the stations provided with gunpowder, rockets, &c.

Corporal Bastard, Royal Sappers and Miners, was furnished with a pocket chronometer, and received instructions to fire flashes at ten-minute intervals, commencing each night at 8h. 30m., and ending at 9h. 30m., St. Regis mean time. Major Graham's party was to commence firing at 8h. 25m. and every ten minutes until 9h. 35m. It was afterwards found better, on account of the long twilight, to commence later, and continue until 10h. 30m.

The flashes were fired by the chronometer time with great precision, as can be seen by reference to the observations. A rocket was also fired each night five minutes before commencing, and three or four were fired at five-minute intervals after the flashing was completed. The observations of these rockets were found to be not nearly so satisfactory as the flashes; very few corresponding observations were made, and they are rejected in computation for difference of longitude.

On the last three nights of the flashing, the moon was exceedingly bright, but this was not found materially to increase the difficulty of observing the flashes, which could be seen in that clear atmosphere very distinctly with the naked eye, although the distance of the hill (Lyon Mountain) on which they were fired, was afterwards ascertained to be forty-three miles.

The difference of longitude between Rouse's Point and a station on the 45th parallel near Lake Memphramagog, taken up by Captain Robinson, was afterwards obtained in a similar manner by observations of flashes fired from the top of a mountain called Jay Peak.

The difference between Rouse's Point and a station on the 45th parallel at Richford, taken up by one of the American parties, and between Richford and Lake Memphramagog, were found in the same manner.

Comparisons of chronometers were made by the American astronomical parties between Rouse's Point and Albany, and again between Albany and Cambridge Observatory at Boston, by which means the whole of the astronomical stations along the Boundary and those of Quebec, St. Helen's, &c., are connected with Boston.

A copy of the observations of flashes between Quebec and the hill near the North-West Branch, called Lake Hill, and of those between St. Regis and Rouse's Point, are appended to this report; and also an abstracted account of the rates of the chronometers used by Lieutenant Pipon during the expedition, taken from the Book of Comparisons, in which the rates may be found rather more in detail, if required.

March 1846.

(Signed)

JOHN H. PIPON,
Lieutenant, Royal Engineers.

Sidereal Box Chronometer Frodsham 2.

STATION.	Date.	Range during month.		Average or mean of rates determined during the month.	REMARKS.
		From To			
		From	To		
	1843				
Greenwich	April	+0.5	-1.7	-0.4	At Greenwich Observatory, from March 28 to April 15.
On passage out ..	April & May	..	..	+1.95	
Madawaska	July	+2.40	-2.24	-0.10	Kept in block-house; never moved out.
Ditto	August	-0.03	-2.54	-1.51	
Pohenagamook ..	Sept.	+1.63	-1.85	+0.26	In camp.
Black River	Oct.	+2.10	-3.26	+0.04	In tent.
Ditto	Nov.	+1.29	-1.30	+0.20	In log-hut.
Ditto	Dec.				
	1844				
Ditto	January	+0.53	-4.85	-1.54	Ditto. Sent with pocket chronometers for comparison.
South-West Branch ..	July	-0.74	-3.74	-1.44	
Quebec	Sept.	-1.54	-2.40	-1.88	In house
Ditto	Oct.	-0.00	-3.44	-1.69	Warmed by stove.
Ditto	Nov.	-0.51	-6.00	-2.71	"
Ditto	Dec.	-0.64	-6.15	-3.49	"
	1845				
Ditto	January	-1.35	-6.85	-2.70	"
Ditto	Feb.	-1.70	-9.24	-3.91	"
Ditto	March	+0.45	-4.38	-2.77	"
Ditto	April	-0.20	-2.83	-1.90	"
Ditto	May	-0.72	-5.50	-2.17	Sent to St. Helen's with pocket chronometer for comparison for difference of longitude.
St. Regis	June	-0.10	-7.68	-3.78	
Ditto	July	+1.08	-5.48	-2.88	
Russeltown	August	-3.64	-6.75	-5.16	

Sidereal Box Chronometer Arnold 341. (Standard.)

1843					Rate noted at Observatory from March 28 to April 15.
Greenwich	April	+0.6	-3.0	-0.77	
On passage out	April & May	..	..	-0.48	
Madawaska	July	+0.34	-1.80	-0.39	Kept in the block-house when not observing. Temperature very even.
Ditto	August	+0.25	-1.03	-0.41	
Lake Pohenaganook ..	August	-1.89	-2.53	-2.27	Kept in tent.
Ditto	Sept.	-1.87	-3.26	-2.22	
Black River	Sept.	-2.25	-2.25	-2.25	In tent.
Ditto	Oct.	+0.16	-1.62	-0.52	In wooden house with stove. Tem- perature in house occasionally below zero, Fahrenheit.
Ditto	Nov.	-0.13	-0.84	-0.48	
Ditto	Dec.	..	..	-2.85	
1844					
Ditto	January	-0.78	-3.54	-1.83	In tent.
South-West Branch ..	July	+0.26	-0.25	-0.11	
Quebec,	Sept.	-0.04	-0.83	-0.51	
Ditto	Oct.	+0.14	-1.06	-0.29	

Sidereal Box Chronometer 341. —(Continued.)

STATION.	Date.	Rates.		Average or mean of Rates determined during the month.	REMARKS.
		Range during month.			
		From	To		
	1844	s.	s.	s.	
Quebec	Nov.	+0·01	—0·64	—0·31	The chronometers at Quebec were kept in one of the soldiers' rooms in the cavalry barracks adjoining the Observatory. The temperature was generally tolerably even, but the standard was exposed to very severe cold when carried to the Observatory on nights that observations were being made.
Ditto	Dec.	—0·34	—0·41	—0·36	
	1845				
Ditto	January	+0·20	—0·88	—0·47	At St. Regis and Russeltown the chronometers were kept in camp, in a box buried under ground to protect them from the heat which was very great.
Ditto	Feb.	+0·12	—0·48	—0·09	
Ditto	March	+0·12	+1·09	+0·61	
Ditto	April	+1·39	+0·94	+1·36	
Ditto	May	+2·06	+0·46	+1·20	
St. Regis	June	+1·61	+0·88	+1·25	
Ditto	July	+1·61	+0·89	+1·18	
Russeltown	August	+1·76	+1·17	+1·51	

Mean Time Pocket Chronometer Molyneux 3148.

	1843				
Greenwich	April	..	..	—1·7	Rate, obtained from chronometers.
On passage out ..	April	..	..	—2·59	
Madawaska	July	—0·74	—3·98	—2·13	Travelling frequently between astronomical stations.
Ditto	August	—0·69	—3·69	—1·75	
Lake Pohenagamook ..	Sept.	—1·84	—4·48	—3·55	Ditto.
Great Black River ..	Oct.	—1·53	—11·82	—5·67	Ditto.
Ditto	Nov.				At Forks of the St. John.
Ditto	Dec.				
	1844				
	Jan.				
North-West Branch ..	July	+0·28	—5·28	—2·97	Making interchanges.
Quebec	Sept.	—2·37	—4·82	—3·96	
Ditto	Oct.	—0·81	—5·25	—2·92	Kept perfectly still.
Ditto	Nov.	—0·04	—10·30	—3·95	
Ditto	Dec.	—0·27	—10·00	—4·80	
	1845				
Ditto	January	—0·58	—11·36	—4·36	Travelling between Quebec and Montreal.
Ditto	Feb.	—1·07	—8·35	—4·13	
Ditto	March	+1·35	—8·28	—4·76	
Ditto	April	—0·72	—7·16	—3·66	
Ditto	May	—0·17	—4·06	—2·53	
St. Regis	June	+0·07	—10·05	—4·20	Ditto, St. Regis and Montreal.
Ditto	July	+1·38	—4·27	—1·56	

Mean Time Pocket Chronometer Molyneux 3226.

	1843				
Greenwich	April	..	..	—4·8	
On passage out ..	April	..	..	—4·50	
Madawaska	July	+3·35	+0·22	+1·81	Travelling between astronomical stations frequently.
Ditto	August	+2·96	+2·43	+2·62	
Pohenagamook ..	Sept.	+4·93	+3·15	+3·78	Ditto.

Mean Time Pocket Chronometer No. 3226.—(Continued.)

STATION.	Date.	Rates.		Average or mean of Rates determined during the month.	REMARKS.
		Range during month.			
		From	To		
	1843	s.	s.	s.	
Black River	Oct	+3·83	+2·82	+3·29	
Ditto	{ Nov.				At Forks of St. John.
	{ Dec.				
	1844				
	{ Jan.				
South-West Branch ..	July	+9·09	+8·53	+8·71	Travelling between stations.
Quebec.	Sept.	+10·31	+12·79	+11·64	At Indian range with Serjeant
Ditto	Oct.	+13·15	+12·37	+12·92	McGuckin.
Ditto	Nov.	+15·08	+12·45	+14·02	
Ditto	Dec.	+16·09	+8·72	+13·89	
	1845				
Ditto	January	+16·02	+14·27	+15·49	At Quebec.
Ditto	Feb.	+19·97	+12·79	+16·14	
Ditto	March	+19·58	+14·15	+16·88	
Ditto	April	+19·92	+15·37	+16·84	
Ditto	May	+17·33	+15·37	+16·52	Travelling between Quebec and
St. Regis	June	+22·97	+11·77	+17·37	Montreal.
Ditto	July	+15·96	+11·04	+12·75	Ditto, between Montreal and St.
					Regis.

Mean Time Pocket Chronometer Molyneux 3227.

Greenwich	1843				Travelling frequently between as- tronomical stations. Ditto.
	April	..	..	—0·5	
	On passage out	April	..	—4·91	
Madawaska .. .	July	+3·46	+0·91	+2·02	
Ditto	August	+2·81	+0·00	+1·35	
Pohenaganook ..	Sept.	+8·97	+3·51	+5·51	Ditto.
Black River .. .	Oct.	+8·87	+6·29	+7·29	Ditto.
	Nov.				At Forks of St. John.
	Dec.				
	1844				
South-West Branch ..	Jan.				Travelling between stations.
	July	+6·06	—2·18	+3·60	
	Sept.	+1·65	—1·89	—0·14	
Quebec.	Oct.	+3·46	+0·37	+1·54	
Ditto	Nov.	+7·96	+2·92	+4·72	
Ditto	Dec.	+9·96	+3·51	+5·75	With Corporal Bastard on Lyon Mountain.
Ditto	1845				
	January	+7·72	+3·94	+5·80	
	Feb.	+12·66	+4·33	+7·02	
Ditto	March	+7·14	+1·50	+5·70	
Ditto	April	+6·11	—1·43	+3·71	
Ditto	May	+5·00	+2·61	+3·91	
St. Regis	June	+7·31	+3·19	+4·90	
Ditto	July	+6·06	+7·31	+6·68	

(Signed) J. H. PIPON, Lieutenant, Royal Engineers.

OBSERVATIONS for Difference of Longitude between the Astronomical Stations at Quebec and Lake Hill, near North-West Branch, by flashes of gunpowder fired on the top of an intermediate hill.

Name of Station.	Date, Hour, and Minute.		Flashes observed.	Errors of Chrons. on Sidl. Time of Station.	Sidereal Time of Observation.	Difference of Longitude.
	1844	H. M.	H. M. S.	M. S.	H. M. S.	M. S.
Quebec .. Lake Hill ..	Sep. 23,	8 0	20 6 58 20 9 30	0 11·53 fast 2 5·29 slow	20 6 46·47 20 11 35·29	4 48·82
Quebec .. Lake Hill ..	" "	8 10	20 17 34 20 20 14·5	0 11·53 fast 2 5·29 slow	20 17 22·47 20 22 19·79	4 57·32 * reject
Quebec .. Lake Hill ..	" "	8 20	20 27 5·6 20 29 36·5	0 11·53 fast 2 5·29 slow	20 26 54·07 20 31 41·79	4 47·72
Quebec .. Lake Hill ..	" "	8 30	20 36 59·5 20 39 31	0 11·53 fast 2 5·29 slow	20 36 47·97 20 41 36·29	4 48·32
Quebec .. Lake Hill ..	" "	8 40	20 48 14·1 20 50 44·5	0 11·53 fast 2 5·29 slow	20 48 2·57 20 52 49·79	4 47·22
Quebec .. Lake Hill ..	" "	9 0	21 7 22·3 21 9 53	0 11·53 fast 2 5·29 slow	21 7 10·77 21 11 58·29	4 47·52
Quebec .. Lake Hill ..	" "	9 10	21 16 55·3 21 19 27	0 11·53 fast 2 5·29 slow	21 16 43·97 21 21 32·29	4 48·32
Quebec .. Lake Hill ..	" "	9 20	21 27 21 21 29 52	0 11·53 fast 2 5·29 slow	21 27 9·46 21 31 57·29	4 47 82
Quebec .. Lake Hill ..	" "	9 30	21 36 44·2 21 39 15·5	0 11·53 fast 2 5·29 slow	21 36 32·67 21 41 20·79	4 48·12
Quebec .. Lake Hill ..	" "	9 40	21 47 2·5 21 49 33·5	0 11·53 fast 2 5·29 slow	21 46 50·97 21 51 38·79	4 47 82
Quebec .. Lake Hill ..	" "	9 50	21 58 43·5 22 1 14	0 11·53 fast 2 5·29 slow	21 58 39·97 22 3 19·29	4 47·32

Sum of 10 observations 10) 47 59·00

Mean difference of longitude by flashes observed on September 23 = 4 47·90

Quebec .. Lake Hill ..	Sep. 25,	8 0	20 16 9·5 20 18 40	0 9·91 fast 2 6·21 slow	20 15 59·59 20 20 46·21	4 46·62
Quebec .. Lake Hill ..	" "	8 10	20 28 2·6 20 30 33	0 9·91 fast 2 6·21 slow	20 27 52·69 20 32 39·21	4 46·52
Quebec .. Lake Hill ..	" "	8 40	20 58 54 21 1 24·5	0 9·91 fast 2 6·21 slow	20 58 44·09 21 3 30·71	4 46·62
Quebec .. Lake Hill ..	" "	8 50	22 5 31·4 22 8 1·5	0 9·91 fast 2 6·21 slow	22 5 21·49 22 10 7·71	4 46·22

Sum of 4 observations 4) 19 5·98

Mean difference of longitude by flashes observed on September 25 = 4 46·49

* Probably an error of 10 seconds.

Name of Station.	Date, Hour, and Minute.	Flashes observed.	Errors of Chrons. on Sidl. Time of Station.	Sidereal Time of Observation.	Difference of Longitude.
	1844 H. M.	H. M. S.	H. S.	H. M. S.	M. S.
Quebec .. Lake Hill ..	Sep. 27, 8 20	20 42 34.6 20 45 4	0 9.10 fast 2 7.15 slow	20 42 25.50 20 47 11.15	4 45.65
Quebec .. Lake Hill ..	" " 8 30	20 53 13.0 20 55 44	0 9.10 fast 2 7.15 slow	20 53 4.80 20 57 51.15	4 46.35
Quebec .. Lake Hill ..	" " 8 50	21 13 19.5 21 15 49.5	0 9.10 fast 2 7.15 slow	21 13 10.40 21 17 56.65	4 46.25
Quebec .. Lake Hill ..	" " 9 20	21 43 23.4 21 45 53.5	0 9.10 fast 2 7.15 slow	21 43 14.30 21 48 0.65	4 46.35
Quebec .. Lake Hill ..	" " 9 40	22 3 23 22 5 52.5	0 9.10 fast 2 7.15 slow	22 3 13.90 22 7 59.65	4 45.75
Quebec .. Lake Hill ..	" " 9 50	22 13 31.7 22 16 1.5	0 9.10 fast 2 7.15 slow	22 13 22.60 22 18 8.65	4 46.05
Quebec .. Lake Hill ..	" " 10 0	22 22 49.5 22 25 19	0 9.10 fast 2 7.15 slow	22 22 40.40 22 27 26.15	4 45.75

Sum of 7 observations 7) 33 22.15

Mean difference of longitude by flashes observed on September 27 = 4 46.02

Quebec .. Lake Hill ..	Sep. 28, 8 0	20 26 52.2 20 29 22	0 8.35 fast 2 8.23 slow	20 26 43.85 20 31 30.23	4 46.38
Quebec .. Lake Hill ..	" " 8 10	20 36 50.5 20 39 19.5	0 8.35 fast 2 8.23 slow	20 36 42.15 20 41 27.73	4 45.58
Quebec .. Lake Hill ..	" " 8 20	20 50 9.6 20 52 39	0 8.35 fast 2 8.23 slow	20 50 1.25 20 54 47.23	4 45.98
Quebec .. Lake Hill ..	" " 8 40	21 7 25.8 21 9 55	0 8.35 fast 2 8.23 slow	21 7 17.45 21 12 3.23	4 45.78
Quebec .. Lake Hill ..	" " 8 50	21 17 30.5 20 20 0	0 8.35 fast 2 8.23 slow	21 17 22.15 21 22 8.23	4 46.08
Quebec .. Lake Hill ..	" " 9 0	21 27 26.7 21 29 56	0 8.35 fast 2 8.23 slow	21 27 18.35 21 32 4.23	4 45.88
Quebec .. Lake Hill ..	" " 9 10	21 37 19.7 21 39 49	0 8.35 fast 2 8.23 slow	21 37 11.35 21 41 57.23	4 45.88
Quebec .. Lake Hill ..	" " 9 20	21 47 6.4 21 49 35.5	0 8.35 fast 2 8.23 slow	21 46 58.05 21 51 43.73	4 45.68
Quebec .. Lake Hill ..	" " 9 30	21 57 9.7 21 59 39	0 8.35 fast 2 8.23 slow	21 57 1.35 22 1 47.23	4 45.88
Quebec .. Lake Hill ..	" " 9 40	22 7 10.8 22 9 40	0 8.35 fast 2 8.23 slow	22 7 2.45 22 11 48.23	4 45.78
Quebec .. Lake Hill ..	" " 9 50	22 17 31.3 22 20 0	0 8.35 fast 2 8.23 slow	22 17 22.95 22 22 8.23	4 45.28
Quebec .. Lake Hill ..	" " 10 0	22 27 18.1 22 29 46.5	0 8.35 fast 2 8.23 slow	22 27 9.75 22 31 54.73	4 44.93

Sum of 12 observations 12) 57 9.16

Mean difference of longitude by flashes observed on September 28 = 4 45.76

Name of Station.	Date, Hour, and Minute.	Flash observed.	Error of Chronr. on Sidl. Time of Stations.	Sidereal Time of Observation.	Difference of Longitude.
	1844 H. M.	H. M. S.	M. S.	H. M. S.	M. S.
Quebec ..	Sep. 30, 8 10	20 44 36.4	0 8.26 fast	20 44 28.14	4 45.67
Lake Hill ..		20 47 3	2 10.81 slow	20 49 13.81	
Quebec ..	" " 8 20	20 55 3.5	0 8.26 fast	20 54 55.24	4 45.57
Lake Hill ..		20 57 30	2 10.81 slow	20 59 40.81	
Quebec ..	" " 8 40	21 15 19.5	0 8.26 fast	21 15 11.24	4 45.57
Lake Hill ..		21 17 46	2 10.81 slow	21 19 56.81	
Quebec ..	" " 8 50	21 25 29.6	0 8.26 fast	21 25 21.34	4 44.47
Lake Hill ..		21 27 55	2 10.81 slow	21 30 5.81	
Quebec ..	" " 9 0	21 35 25.6	0 8.26 fast	21 35 17.34	4 45.47
Lake Hill ..		21 37 52	2 10.81 slow	21 40 2.81	
Quebec ..	" " 9 10	21 45 27.3	0 8.26 fast	21 45 19.04	4 44.77
Lake Hill ..		21 47 53	2 10.81 slow	21 50 3.81	
Quebec ..	" " 9 20	21 55 26.4	0 8.26 fast	21 55 18.14	4 45.67
Lake Hill ..		21 57 53	2 10.81 slow	22 0 3.81	
Quebec ..	" " 9 50	22 25 47.6	0 8.26 fast	22 25 39.34	4 45.47
Lake Hill ..		22 28 14	2 10.81 slow	22 30 24.81	

Sum of 8 observations 8) 38 2.66

Mean difference of longitude by flashes observed on September 30 = 4 45.33

Quebec ..	Oct. 2, 8 20	21 1 16.2	0 8.26 fast	21 1 7.94	4 46.1
Lake Hill ..		21 3 40.5	2 13.45 slow	21 5 53.95	
Quebec ..	" " 8 30	21 11 7.5	0 8.26 fast	21 10 59.24	4 46.71
Lake Hill ..		21 13 32.5	2 13.45 slow	21 15 45.95	
Quebec ..	" " 8 40	21 20 53.8	0 8.26 fast	21 20 45.54	4 46.41
Lake Hill ..		21 23 18.5	2 13.45 slow	21 25 31.95	
Quebec ..	" " 8 50	21 31 54.6	0 8.26 fast	21 31 46.34	4 46.61
Lake Hill ..		21 34 19.5	2 13.45 slow	21 36 32.95	
Quebec ..	" " 9 0	21 41 38.3	0 8.26 fast	21 41 30.04	4 46.41
Lake Hill ..		21 44 3	2 13.45 slow	21 46 16.45	

Sum of 5 observations 5) 23 52.15

Mean difference of longitude by flashes observed on October 2 = 4 46.43

ABSTRACT OF FOREGOING.

September 23, mean result of corresponding observations of 10 flashes	=	4	47.90
" 25, " " "	=	14	" = " 46.49
" 27, " " "	=	7	" = " 46.02
" 28, " " "	=	12	" = " 45.76
" 30, " " "	=	8	" = " 45.33
October 2, " " "	=	5	" = " 46.43
	6)		277.93

Astronomical Station at Lake Hill, east of Astronomical Station at Quebec .. 4 46.32

(Signed) JOHN H. PIPON,
Lieutenant, Royal Engineers.

The flashes observed at St. Regis were noted with the sidereal chronometer Frodsham 2, which had to be carried each evening from the Observatory to the top of the hill, a distance of rather more than half a mile, but was compared with the standard before leaving and after returning to the Observatory.

The error of chronometer Frodsham 2 is deduced as under:—

Date, Hour, and Minute.	Time by Standard Chronometer.	From Transit Book. Stand. Chron. fast.	True Sidereal Time of Station.	Time by Frodsham No. 2.	Frodsham No. 2. Fast.	Mean Error at Time of Observation.
H. M.	H. M. S.	M. S.	H. M. S.	H. M.	M. S.	S. H. M.
July 14, 7 10	14 40 8.5	1 25.87	14 38 42.63	14 39	0 17.37	} 17.16 at 9 15
" 10 10	17 37 9.0	1 26.07	17 35 42.93	17 36	17.07	
" 15 7 55	15 25 11.0	1 27.53	15 23 43.47	15 24	16.53	} 16.25 at 9 40
" 11 20	18 51 11.8	1 27.79	18 49 44.01	18 50	15.99	
" 17 8 0	15 42 18.7	1 29.44	15 40 49.26	15 41	10.74	} 10.42 at 9 50
" 11 40	19 23 19.5	1 29.60	19 21 49.90	19 23	10.10	
" 18 8 20	16 5 25.4	1 30.35	16 3 55.03	16 4	4.95	} 4.77 at 9 30
" 11 40	19 23 26.0	1 30.47	19 21 55.33	19 22	4.47	
" 19 8 5	15 53 30.5	1 31.24	15 51 59.26	15 52	0.74	} 0.30 at 9 50
" 11 40	19 22 31.5	1 31.39	19 21 0.11	19 21	Slow 0.11	

OBSERVATIONS for Difference of Longitude between the Astronomical Stations of Lieutenant Pipon, Royal Engineers, at St. Regis, and Major Graham, United States' Topographical Engineers, at Rouse's Point, by flashes of gunpowder and rockets fired from the top of Lyon Mountain, New York.

Name of Station.	Date, Hour, and Minute.	Flash observed.	Error of Chron. on Sidl. Time of Station.	Sidereal Time of Observation.	Difference of Longitude.
	H. M.	H. M. S.	H. M. S.	H. M. S.	M. S.
St. Regis	July 14, 8 45	16 16 2.0	0 0 17.16 fast	16 15 44.84	+5 14.55 + reject.
*Rouse's Point		13 39 17.8	4 49 24.18 "	16 20 59.39	
			(On mean time.)		
St. Regis	" " 8 50	16 21 3.5	0 0 17.16 "	16 20 46.34	5 13.67
*Rouse's Point		13 44 17.6	4 49 24.18 "	16 26 00.01	
St. Regis	" " 8 55	16 26 3.5	0 0 17.16 "	16 25 46.34	5 13.49
*Rouse's Point		13 49 16.6	4 49 24.18 "	16 30 59.83	
St. Regis	" " 9 0	16 31 5.0	0 0 17.16 "	16 30 47.84	5 13.91
*Rouse's Point		13 54 17.7	4 49 24.18 "	16 36 01.75	
St. Regis	" " 9 5	16 36 6.0	0 0 17.16 "	16 35 48.84	5 13.43
Rouse's Point		16 44 36.2	0 3 33.93 "	16 41 02.27	
St. Regis	" " 9 10	16 41 6.5	0 0 17.16 "	16 40 49.34	5 13.73
Rouse's Point		16 49 37.0	0 3 33.93 "	16 46 03.07	
St. Regis	" " 9 15	16 46 7.3	0 0 17.16 "	16 45 50.14	5 13.98
*Rouse's Point		14 09 17.6	4 49 24.18 "	16 51 04.12	

Carried forward .. 31 22.24

* Those observations marked thus (*) were noted with a mean time chronometer.
Those marked thus (D) have not been quite so well observed as the others.

Name of Station.	Date, Hour, and Minute.	Flash observed.	Error of Chrono. on Sidl. Time of Station.	Sidereal Time of Observation.	Difference of Longitude.
	1844 H. M.	H. M. S.	H. M. S.	Brought forward	31 22.21
St. Regis .. Rouse's Point	July 14, 9 20	16 51 8.0 16 59 38.2	0 0 17.16 fast 0 3 33.93 "	16 50 50.84 16 56 04.27	5 13.43
St. Regis .. Rouse's Point	" " 9 25	16 56 8.5 17 4 39.0	0 0 17.16 " 0 3 33.93 "	16 55 51.34 17 1 05.07	5 13.73
St. Regis .. Rouse's Point	" " 9 30	17 1 10.3 17 9 40.5	0 0 17.16 " 0 3 33.93 "	17 0 53.14 17 6 6.57	5 13.43

Sum of 9 observations 9) 47 2.80

Mean difference of longitude by flashes observed on July 14 = 5 13.64

St. Regis .. *Rouse's Point	July 15, 8 30	16 4 52.7 13 24 13.0	0 0 16.25 fast 4 49 22.73 "	16 4 36.45 16 9 50.12	5 13.67
St. Regis .. *Rouse's Point	" " 8 35	16 9 53.4 13 29 12.8	0 0 16.25 " 4 49 22.73 "	16 9 37.15 16 14 50.74	5 13.59
St. Regis .. Rouse's Point	" " 8 40	16 14 54.5 16 23 26.3	0 0 16.25 " 0 3 34.60 "	16 14 38.25 16 19 51.70	5 13.45
St. Regis .. Rouse's Point	" " 8 45	16 19 55.5 16 28 27.2	0 0 16.25 " 0 3 34.60 "	16 19 39.25 16 25 52.60	5 13.95
St. Regis .. *Rouse's Point	" " 8 50	16 24 56 13 44 13	0 0 16.25 " 4 49 22.73 "	16 24 39.75 16 29 53.45	5 13.70
St. Regis .. Rouse's Point	" " 8 55	16 29 56.3 16 38 28.1	0 0 16.25 " 0 3 34.60 "	16 29 40.05 16 34 53.50	5 13.45
St. Regis .. Rouse's Point	" " 9 0	16 34 58.6 16 43 30.3	0 0 16.25 " 0 3 34.60 "	16 34 42.35 16 39 55.70	5 13.35
St. Regis .. Rouse's Point	" " 9 5	16 39 59 16 48 30.8	0 0 16.25 " 0 3 34.60 "	16 39 42.75 16 44 56.20	5 13.45
St. Regis .. Rouse's Point	" " 9 10	16 44 59.2 16 53 30.9	0 0 16.25 " 0 3 34.60 "	16 44 42.95 16 49 56.30	5 13.35
St. Regis .. Rouse's Point	" " 9 15	16 50 0.3 16 58 32	0 0 16.25 " 0 3 34.60 "	16 49 44.05 16 54 57.40	5 13.35
St. Regis .. Rouse's Point	" " 9 20	16 55 1.5 17 3 33.5	0 0 16.25 " 0 3 34.60 "	16 54 45.25 16 59 58.90	5 13.65
St. Regis .. Rouse's Point	" " 9 25	17 0 2.3 17 8 34.1	0 0 16.25 " 0 3 34.60 "	16 59 46.05 17 4 59.50	5 13.45
St. Regis .. Rouse's Point	" " 9 30	17 5 3 17 13 34.5	0 0 16.25 " 0 3 34.60 "	17 4 46.75 17 9 59.60	5 13.15
St. Regis .. Rouse's Point	" " 9 35	17 10 3.5 17 18 35.3	0 0 16.25 " 0 3 34.60 "	17 9 47.25 17 15 00.70	5 13.45
St. Regis .. Rouse's Point	" " 9 40	17 15 4.8 17 23 36.8	0 0 16.25 " 0 3 34.60 "	17 14 48.55 17 20 2.20	5 13.65
St. Regis .. Rouse's Point	" " 9 45	17 20 5.4 17 28 37.35	0 0 16.25 " 0 3 34.60 "	17 19 49.15 17 25 2.75	5 13.60
St. Regis .. Rouse's Point	" " 9 50	17 25 6.5 17 33 38.1	0 0 16.25 " 0 3 34.60 "	17 24 50.25 17 30 3.50	5 13.25
St. Regis .. Rouse's Point	" " 10 0	17 35 8.2 17 43 40	0 0 16.25 " 0 3 34.60 "	17 34 51.95 17 40 5.40	5 13.45
St. Regis .. Rouse's Point	" " 10 5	17 40 8.8 17 48 40.6	0 0 16.25 " 0 3 34.60 "	17 35 52.55 17 45 06.00	5 13.45

Carried forward 99 15.81

* Those observations marked thus (*) were noted with a mean time chronometer.

Name of Station.	Date, Hour, and Minute.	Flash observed.	Error of Chrono. on Sidl. Time of Station.	Sidereal Time of Observation.	Difference of Longitude.
	1844			Brought forward	99 15.81
St. Regis	July 15, H. M.	H. M.	H. M. S.	H. M. S.	M. S.
Rouse's Point	" " 10 10	17 45 3 17 53 41.3	0 16.25 fast 3 34.60 "	17 44 53.05 17 50 6.70	5 13.65
St. Regis	" " 10 15	17 50 10.5 17 58 42.3	0 16.25 " 3 34.60 "	17 49 54.25 17 55 7.70	5 13.45
St. Regis	" " 10 20	17 55 11.4 18 3 43.3	0 16.25 " 3 34.60 "	17 54 55.15 18 0 8.70	5 13.55
St. Regis	" " 10 25	18 0 12 18 8 43.9	0 16.25 " 3 34.60 "	17 59 55.75 18 5 9.30	5 13.55
St. Regis	" " 10 30	18 5 13 18 13 45	0 16.25 " 3 34.60 "	18 4 56.75 18 10 10.40	5 13.65
St. Regis	" " 10 35	18 10 33 18 19 3.8	0 16.25 " 3 34.60 "	18 10 16.75 18 15 29.20	5 12.45 (reject.)
St. Regis	" " 10 40	D 18 15 35	0 16.25 "	18 15 15.75	
Rouse's Point	(Rocket burst.)				

Sum of 24 observations 125 23.66

Mean difference of longitude by flashes observed on July 15 = 5 13.48

St. Regis	July 17, 9 0	16 42 44.5 16 51 21.4	0 10.42 fast 3 33.88 "	16 42 34.08 16 47 47.52	5 13.44
Rouse's Point	" " 9 5	16 47 46.5 16 56 23.5	0 10.42 " 3 33.88 "	16 47 36.08 16 52 49.62	5 13.54
St. Regis	" " 9 10	16 52 45.3 17 1 22.2	0 10.42 " 3 33.88 "	16 52 34.88 16 57 48.32	5 13.44
St. Regis	" " 9 15	16 57 46 17 6 23.2	0 10.42 " 3 33.88 "	16 57 35.58 17 2 49.32	5 13.74
St. Regis	" " 9 20	D 17 2 47 17 11 24.1	0 10.42 " 3 33.88 "	17 2 36.58 17 7 50.22	5 13.64
St. Regis	" " 9 25	17 7 48 17 16 25	0 10.42 " 3 33.88 "	17 7 37.58 17 12 51.12	5 13.54
St. Regis	" " 9 30	17 12 48.5 17 21 25.6	0 10.42 " 3 33.88 "	17 12 38.08 17 17 51.72	5 13.64
St. Regis	" " 9 35	17 17 50.4 17 26 27.2	0 10.42 " 3 33.88 "	17 17 39.98 17 22 53.32	5 13.34
St. Regis	" " 9 40	17 22 51.2 17 31 28.1	0 10.42 " 3 33.88 "	17 22 40.78 17 27 54.22	5 13.44
St. Regis	" " 9 45	17 27 51 14 39 07.8	0 0 10.42 " 4 49 18.84 "	17 27 40.58 17 32 54.24	5 13.66
*Rouse's Point	" " 9 50	17 32 56.2 14 44 14.7	0 0 10.42 " 4 49 18.84 "	17 32 45.78 17 38 01.98	+5 16.20 + reject.
St. Regis	" " 10 0	17 42 54.4 17 51 31.4	0 0 10.42 " 0 3 33.88 "	17 42 43.98 17 44 57.52	5 13.54
St. Regis	" " 10 5	17 47 55 4 49 08.3	0 0 10.42 " 4 49 18.84 "	17 47 44.58 17 52 58.03	5 13.45
*Rouse's Point	" " 10 10	17 52 56.5 18 1 33.5	0 0 10.42 " 0 0 33.88 "	17 52 46.08 17 57 59.62	5 13.54
St. Regis	" " 10 10				
Rouse's Point					

Carried forward 67 55.95

* Those observations marked thus (*) were noted with a mean time chronometer.
Marked thus (D) have not been quite so well observed as the others.

Name of Station.	Date, Hour, and Minute.	Flash observed.	Error of Chron. on Sidl. Time of Station.	Sidereal Time of Observation.	Difference of Longitude.
	1844 H. M.	H. M. S.	H. M. S.	Brought forward	67 55-96
St. Regis	July 17, 10 20	18 3 58	0 0 10-42 fast	18 3 47-58	
*Rouse's Point		15 14 09	4 49 18-84 "	18 8 01-19	5 13-61
St. Regis	" " 10 25	18 7 58-7	0 0 10-42 "	18 7 48-28	
Rouse's Point		18 16 35-7	0 3 33-88 "	18 13 1-82	5 13-54
St. Regis	" " 10 30	18 12 58	0 0 10-42 "	18 12 47-58	
Rouse's Point		18 21 35	0 3 33-88 "	18 18 01-12	5 13-54

Sum of 16 observations 16) 83 36-64

Mean difference of longitude by flashes observed on July 17 = 5 13-54

St. Regis	July 18, 9 0	16 46 30-6	0 0 4-77 fast	16 46 25-83	+5 14-31
*Rouse's Point		13 54 0-4	4 49 18-30 "	16 51 40-14	+ reject.
St. Regis	" " 9 5	16 51 30-0	0 4-77 "	16 51 25-23	
Rouse's Point		17 00 13	3 35-10 "	16 56 37-90	5 12-67
St. Regis	" " 9 10	16 56 31-4	0 4-77 "	16 56 26-63	
Rouse's Point		17 05 14-1	3 35-10 "	17 1 39-00	5 12-37
St. Regis	" " 9 15	17 01 31-6	0 4-77 "	17 1 26-83	
Rouse's Point		17 10 15	3 35-10 "	17 6 39-50	5 13-07
St. Regis	" " 9 20	17 06 32-5	0 4-77 "	17 6 27-73	
Rouse's Point		17 15 15-7	3 35-10 "	17 11 40-60	5 12-87
St. Regis	" " 9 25	17 11 34	0 4-77 "	17 11 29-23	
Rouse's Point		17 20 17-1	3 35-10 "	17 16 42-00	5 12-77
St. Regis	" " 9 30	17 16 34	0 4-77 "	17 16 29-23	
Rouse's Point		17 25 17-5	3 35-10 "	17 21 42-40	5 13-17
St. Regis	" " 9 35	17 21 35-2	0 4-77 "	17 21 30-43	
Rouse's Point		17 30 18-6	3 35-10 "	17 26 43-50	5 13-07
St. Regis	" " 9 40	17 26 36	0 4-77 "	17 26 31-23	
Rouse's Point		17 35 19-3	3 35-10 "	17 31 44-20	5 12-97
St. Regis	" " 9 45	d17 31 36-5	0 4-77 "	17 31 31-73	
Rouse's Point		17 40 20	3 35-10 "	17 36 44-90	5 13-17
St. Regis	" " 9 50	17 36 39-4	0 4-77 "	17 36 34-63	
Rouse's Point		17 45 22-6	3 35-10 "	17 41 47-50	5 12-87
St. Regis	" " 10 0	17 46 40-3	0 4-77 "	17 46 35-53	
Rouse's Point		17 55 23	3 35-10 "	17 51 47-90	5 12-37
St. Regis	" " 10 5	17 51 40-5	0 4-77 "	17 51 35-73	
Rouse's Point		18 00 23-5	3 35-10 "	17 56 48-40	5 12-67
St. Regis	" " 10 10	17 56 41-2	0 04-77 "	17 56 36-43	
Rouse's Point		18 05 24-4	3 35-10 "	18 01 49-30	5 12-87
St. Regis	" " 10 15	18 01 42-4	0 04-77 "	18 01 37-63	
Rouse's Point		18 10 25-5	3 35-10 "	18 06 50-40	5 12-77
St. Regis	" " 10 20	18 06 43	0 04-77 "	18 06 38-23	
Rouse's Point		18 15 26	3 35-10 "	18 11 50-90	5 12-67

Sum of 15 observations 15) 78 12-35

Mean difference of longitude by flashes observed on July 18 = 5 12-82

* Those observations marked (*) were noted with a mean time chronometer.
Marked thus (d) have not been quite so well observed as the others.

Name of Station.	Date, Hour, and Minute.	Flash observed.	Error of Chrono. on Sidl. Time of Station.	Sidereal Time of Observation.	Difference of Longitude.
	1844 H. M.	H. M. S.	M. S.	H. M. S.	M. S.
St. Regis Rouse's Point	July 19, 9 10	d17 01 18 17 10 06	0 00:30 fast 3 36:04 "	17 01 17:70 17 06 29:96	+ 5 12:26 + reject
St. Regis Rouse's Point	" " 9 15	17 06 18:5 17 15 06:7	0 00:30 " 3 36:04 "	17 06 18:20 17 11 30:66	5 12:46
St. Regis Rouse's Point	" " 9 20	17 11 19:2 17 20 07:5	0 00:30 " 3 36:04 "	17 11 18:90 17 16 31:46	5 12:56
St. Regis Rouse's Point	" " 9 25	17 16 19:8 17 25 08:3	0 00:30 " 3 36:04 "	17 16 19:50 17 21 32:26	5 12:76
St. Regis Rouse's Point	" " 9 30	17 21 20:4 17 30 08:8	0 00:30 " 3 36:04 "	17 21 20:10 17 26 32:76	5 12:66
St. Regis Rouse's Point	" " 9 35	17 26 21:3 17 35 09:5	0 00:30 " 3 36:04 "	17 26 21:00 17 31 33:46	5 12:46
St. Regis Rouse's Point	" " 9 40	17 31 32:5 17 40 10:5	0 00:30 " 3 36:04 "	17 31 22:20 17 36 34:46	5 12:26
St. Regis Rouse's Point	" " 9 45	17 36 22:6 17 45 11	0 00:30 " 3 36:04 "	17 36 22:30 17 41 34:96	5 12:66
St. Regis Rouse's Point	" " 9 50	17 41 23:8 17 50 12:3	0 00:30 " 3 36:04 "	17 41 23:50 17 46 36:26	5 12:76
St. Regis Rouse's Point	" " 9 55	17 46 24:4 17 55 13	0 00:30 " 3 36:04 "	17 46 24:10 17 51 36:96	5 12:86
St. Regis Rouse's Point	" " 10 0	d17 51 26 18 00 14	0 00:30 " 3 36:04 "	17 51 25:70 17 56 37:96	+ 5 12:26 + reject
St. Regis Rouse's Point	" " 10 5	17 56 26:3 18 05 14:7	0 00:30 " 3 36:04 "	17 56 26:00 18 01 38:66	5 12:66
St. Regis Rouse's Point	" " 10 10	18 01 26:8 18 10 15:3	0 00:30 " 3 36:04 "	18 01 26:50 18 06 39:26	5 12:75
St. Regis Rouse's Point	" " 10 15	18 06 27:5 18 15 16:1	0 00:30 " 3 36:04 "	18 06 27:20 18 11 40:06	5 12:86
St. Regis Rouse's Point	" " 10 20	18 11 28:5 18 20 17	0 00:30 " 3 36:04 "	18 11 28:20 18 16 40:96	5 12:76
St. Regis Rouse's Point	" " 10 25	18 16 29:0 18 25 17:8	0 00:30 " 3 36:04 "	18 16 28:70 18 21 41:76	5 13:06
St. Regis Rouse's Point	" " 10 30	18 21 30:0 18 30 18:6	0 00:30 " 3 36:04 "	18 21 29:70 18 26 42:56	5 12:86
St. Regis Rouse's Point	" " 10 35	18 26 30:5 18 35 19:4	0 00:30 " 3 36:04 "	18 26 30:20 18 31 43:36	5 13:16
St. Regis Rouse's Point	" " 10 40	18 31 31:2 18 40 20	0 00:30 " 3 36:04 "	18 31 30:90 18 36 43:96	5 13:06
St. Regis Rouse's Point	" " 10 45	18 36 32:4 18 45 21	0 00:30 " 3 36:04 "	18 36 32:10 18 41 44:96	5 12:86
Sum of 18 observations					18) 93 49:48
Mean difference of longitude by flashes observed on July 19 =					5 12:75

The two flashes marked d, as doubtfully observed at St. Regis, are rejected.

ABSTRACT OF FOREGOING.

				M.	S.
July 14, mean result of corresponding observations of	9 flashes	=	5	13-64	
15, "	"	=	5	13-48	
17, "	"	=	5	13-54	
18, "	"	=	5	12-82	
19, "	"	=	5	12-75	

Astronomical station at St. Regis, west of astronomical station at Rouse's Point - 5 13-24

(Signed) JOHN H. PIPON,
Lieutenant, Royal Engineers.

